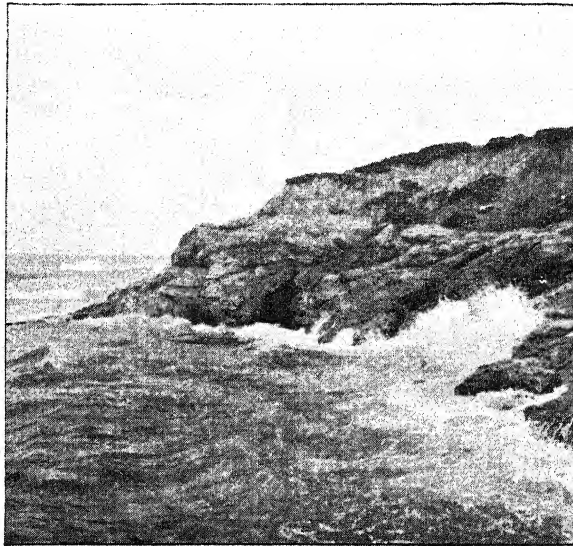


COITAGE AT BONDHURST
From the "Village of Bondhurst" by Sir John Lubbock

CASSELL'S
NATURE BOOK

*A POPULAR DESCRIPTION BY PEN AND
CAMERA OF THE DELIGHTS AND
BEAUTIES OF THE OPEN AIR*



VOLUME IV

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CONTENTS

	PAGE
ANIMAL EPICURES. <i>By</i> GERVAISE TURNBULL	652
ANIMALS, HOW TO KNOW THE WILD. <i>By</i> DOUGLAS ENGLISH, B.A., F.R.P.S. <i>With Photographs by the Author.</i>	
THE BROWN HARE, THE RABBIT 607	
THE SQUIRREL 646	
THE BADGER	675
RATS AND RATTONS	743
BIRDS, HOW TO KNOW THE. <i>By</i> THE REV. MAURICE C. H. BIRD, M.A., M.B.O.U.	
THE SWIMMERS	655, 705
FISH, BRITISH FRESH-WATER, AND THEIR HAUNTS. <i>By</i> WALTER M. GALLICHAN. <i>With Photographs by</i> MRS. C. G. GALLICHAN.	
PIKE AND PERCH 565	
BREAM, ROACH AND RUDD	738
GRASSES. <i>By</i> MAUD U. CLARKE. <i>With Photographs by</i> HENRY IRVING.	
GRASSES, THE HILL 575	
GRASSES OF THE WOODS	603
INSECTS, HOW TO KNOW THE. <i>By</i> JOHN J. WARD. <i>With Photographs by the Author.</i>	
IN WINTER QUARTERS	629
KINSHIP OF PLANTS TO ANIMALS, THE. <i>By</i> WALTER P. WRIGHT	749
LAKES AND THEIR FORMATION. <i>By</i> J. LOMAS, F.G.S., A.R.C.S.	597
MOULDS, THE STORY OF THE. <i>By</i> JOHN J. WARD. <i>With Photo-Micrographs by the Author</i>	688
"OAK APPLE," WHAT IS AN? <i>By</i> HAROLD BASTIN. <i>With Photographs by the Author</i>	693
POND LIFE. <i>By</i> F. MARTIN DUNCAN, F.R.P.S. <i>With Photographs by the Author</i>	592, 670, 719
REPTILES, HOW TO KNOW THE. <i>By</i> DOUGLAS ENGLISH, B.A., F.R.P.S. <i>With Photographs by the Author.</i>	
THE GRASS SNAKE, THE SMOOTH SNAKE	580
RUSHES, THE. <i>By</i> MAUD U. CLARKE. <i>With Photographs by</i> HENRY IRVING	715
SEDGES, THE. <i>By</i> MAUD U. CLARKE. <i>With Photographs by</i> HENRY IRVING	657, 666

	PAGE
SNAIL, THE GARDEN. <i>By</i> JOHN J. WARD. <i>With Photographs by the Author</i> .	735
STONE-TURNING—II. <i>By</i> R. A. STAIG. <i>With Photographs by</i> JOHN A. BALLANTYNE	571
THUNDERSTORMS, CONCERNING. <i>By</i> WILLIAM J. S. LOCKYER, M.A., PH.D., F.R.A.S.	618, 639
TREES GROWING IN BRITAIN, HOW TO KNOW THE. <i>By</i> HENRY IRVING. <i>With Photographs by the Author</i> .	
THE PLUM AND CHERRY GROUP . 587	709
THE APPLE AND PEAR GROUP 614, 634	729
THE ELDER, THE HOLLY, THE LABURNUM, AND THE ACACIA . 681	
THE CONIFERS—FIRS AND PINES .	709
THE CONIFERS—LARCH, CEDARS, CYPRESSES AND YEW . . .	729
VERNAL DAYS. <i>By</i> R. A. STAIG	725
WILD FLOWERS, HOW TO KNOW THE. <i>By</i> THE REV. H. PUREFOY FITZGERALD, F.L.S. <i>With Photographs by</i> HENRY IRVING.	
THE FLOWERS OF THE CHALK DOWNS AND PASTURES 622	698
THE FLOWERS OF THE HEDGEROWS	
WILD GARDEN, THE. <i>By</i> H. H. THOMAS	661

LIST OF PLATES

COTTAGE AT ROUNDHURST. <i>From the Water-Colour Drawing by</i> SUTTON PALMER <i>Frontispiece</i>	
THE SOUTH DOWNS. <i>From the Water-Colour Drawing by</i> COPLEY FIELDING <i>in the Victoria and Albert Museum</i>	597
A WARWICKSHIRE COTTAGE. <i>From the Painting by</i> A. C. WYATT	629
THE CLOCK TOWER, ST. ANNE'S, DUBLIN. <i>From the Water-Colour Drawing by</i> E. A. ROWE	661
SPRINGTIME. <i>From the Painting by</i> A. C. WYATT	693
THE CLIFFS IN JUNE, CORNWALL. <i>From the Painting by</i> ARTHUR J. BLACK	725

BLACKBOARD OUTLINES:—

GRASSES	<i>facing p.</i> 576
INSECT LIFE—HARMFUL INSECTS	630
BIRD LIFE—TYPES OF BIRDS—II.	704
LAND AND FRESH-WATER SHELLS	736

DISSECTIONAL ANATOMICAL MODEL: THE SNAIL.

THE SNAIL

PLATE I.—UPPER SURFACE, WITH SHELL

- | | |
|---|---|
| 1. Anterior Part of the Body | 19. Columella |
| 2. Mouth, on the Under Surface | 20. Apex |
| 3. Large Tentacles, carrying | 21-23. Mantle |
| 4. Eyes | 24. Nephridium, or Kidney |
| 5. Small Tentacles | 25. Auricle of the Heart |
| 6. Lateral Part of the Foot | 26. Ventricle of the Heart |
| 7. Posterior Part of the Foot | 27. Pericardium |
| 8. Mantle Collar | 28. Suture |
| 9. Respiratory Pore | 29. Body Wall |
| 10. Lip of Shell | 30, 31. Right Lobe of Liver |
| 11. Body Whorl | 32, 33. Left Lobe of Liver |
| 12, 13. Spire | 34. Albumen Gland |
| 14. Apex | 35. Ovo-testis, or Hermaphrodite Gland |
| On the under side the Shell is seen in Vertical Section | 36. Genital Pore |
| 15-17. Whorls | 37. Base of Columellar Muscle attaching Body to the Shell |
| 18. Lip | |

PLATE II.—MANTLE CAVITY

A. Before being opened up.

- | | |
|---------------------------|--|
| 1, 2. Mantle Collar | 14, 15. Right Lobe of Liver |
| 3. Respiratory Pore | 16, 17. Left Lobe of Liver |
| 4-6. Mantle | 18. Albumen Gland |
| 7. Nephridium, or Kidney | 19. Ovo-testis, or Hermaphrodite Gland |
| 8. Auricle of the Heart | 20. Large Tentacles, carrying Eyes |
| 9. Ventricle of the Heart | 21. Small Tentacles |
| 10. Pericardium | 22. Genital Pore |
| 11, 12. Suture | 23, 24. Sole of Foot |
| 13. Body Wall | |

B. The Collar is cut through and the Mantle turned back to the right, exposing the Cavity.

- | | |
|---|---|
| 25, 26. Section through the Collar | 31. Ventricle of the Heart |
| 27. Pulmonary Chamber (inner side of Mantle) | 32. Pericardium |
| 28. Vessels which carry the Blood to the Heart, after they have united with | 33. Aorta |
| 29. The great Pulmonary Vein | 34. Nephridium, or Kidney |
| 30. Auricle of the Heart | 35. Ureter |
| | 36. Rectum |
| | 37. Anus |
| | 38, 39. Intestines in the Body Cavity, thinly covered |

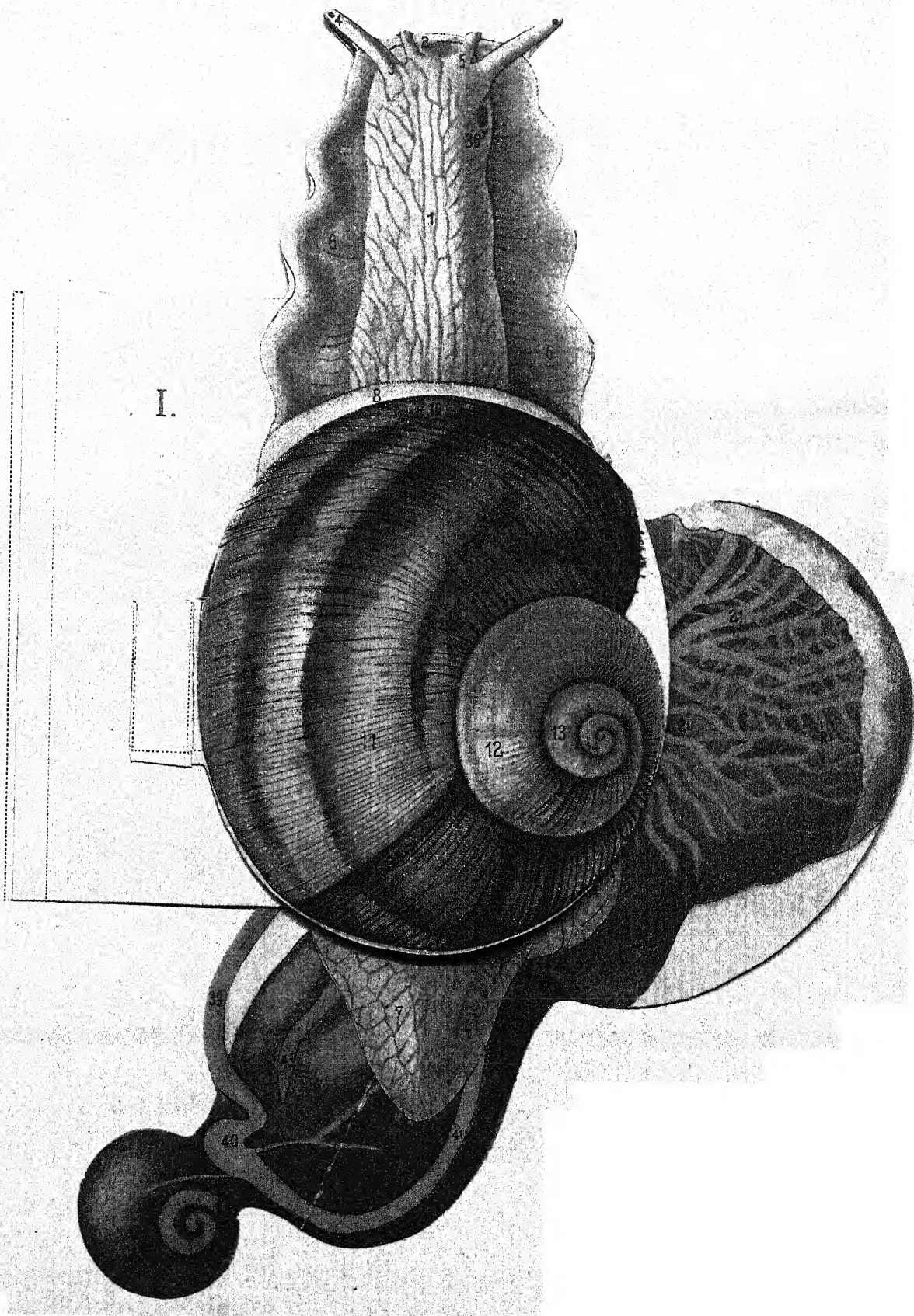
PLATE II.—MANTLE CAVITY (continued)

- | | |
|--|------------------------------------|
| 40. Liver | 46. Penis |
| 41. Intestine (middle portion) | 47. Flagellum of Penis |
| Body Cavity opened in front | 48. Retractor Muscles of the Penis |
| 42. Root of the Radula or Tongue | 49. Vas deferens |
| 43. Oesophagus | 50. Oviduct |
| 44. Salivary Glands | 51. Genital Duct |
| 45. Retractor Muscles of the Large Tentacles | 52. Dart sac |
| | 53. Mucous Gland |

PLATE III.—DIGESTIVE AND GENITAL ORGANS

(The Plate is to be opened out)

- | | |
|---|---|
| 1-19. As in Plate II. | 47. Left Lobe of Liver |
| 20. Pulmonary Chamber | 48, 49. Hepatic Ducts |
| 21. Pulmonary Vein | 50. Hermaphrodite Gland |
| 22. Great Pulmonary Vein | 51. Hermaphrodite Duct |
| 23. Auricle of the Heart | 52. Genital Duct, with |
| 24. Ventricle of the Heart | 53, 53'. Parts of it differentiated as an Oviduct, and |
| 25. Pericardium | 54. Vas deferens |
| 26. Nephridium, or Kidney | 55. Albumen Gland |
| 27. Junction of Kidney and Ureter | 56. Division of the Common Duct into Oviduct and Vas deferens |
| 28. Ureter | 57. Oviduct |
| 29. Pharynx, or Buccal Mass. (This part is to be turned back.) | 58. Dart Sac |
| 30. Radula | 59, 60. Mucous Glands |
| 31. Horny Jaw Plate | 61. Genital vestibule |
| 32. Cerebral Ganglion | 62. Receptaculum seminis, or Sperm Sac |
| 33. Nerve Mass, formed by the Union of the Pedal and Abdominal Ganglion | 63. Duct of Sperm Sac, and |
| 34. Retractor Muscle of the Foot | 64. Enlargement at its junction with Oviduct |
| 35. Oesophagus | 65, 66. Vas deferens |
| 36. Salivary Glands | 67. Penis, in sheath |
| 37, 38. Salivary Ducts | 68. Retractor Muscle of Penis (cut off) |
| 39. Posterior Part of the Oesophagus | 69. Flagellum |
| 40. Stomach | 70. Mantle Collar, in section |
| 41-43. Intestinal Tract | 71, 72. Body Wall, in section |
| 44. Rectum | |
| 45. Anus | |
| 46. Right Lobe of Liver | |





A DYKE WHERE PIKE SPAWN.

BRITISH FRESH-WATER FISH AND THEIR HAUNTS

By WALTER M. GALLICHAN

With Photographs by Mrs. C. G. GALLICHAN

PIKE AND PERCH

NO fish of prey that haunts fresh water is so feared by other fish as the Pike. Its voracity is extraordinary, and it will not even spare the weaker members of its own family, while its dietary ranges from aquatic birds to the fresh-water shrimp. Many are the stories told of the ravenous nature of the Pike, and within my own experience are many instances of its almost omnivorous instinct. Among the live creatures which I have known to fall victims to its hunger are a mole, frogs, young moorhens, flies, and earthworms. There is scarcely any bait used by anglers that has not been taken at one time or another by Pike.

Its depredations among fish of all kinds

make the Pike a very undesirable denizen of salmon and trout rivers. This lurking terror of the waters is detested by everyone concerned in the preservation of streams that breed game fish; and in trout preserves the net, the snare, the trimmer, and the fishing-rod are continually employed to check its increase. But extermination is well-nigh impossible, even in the most-closely protected rivers and lakes, as Pike possess great power of surviving in the struggle for existence. In rivers, such as the Thames, Lea, and Trent, Pike are not regarded as pests, but are accorded all the rights and privileges of their companions, the bream, barbel, roach, and perch; and the

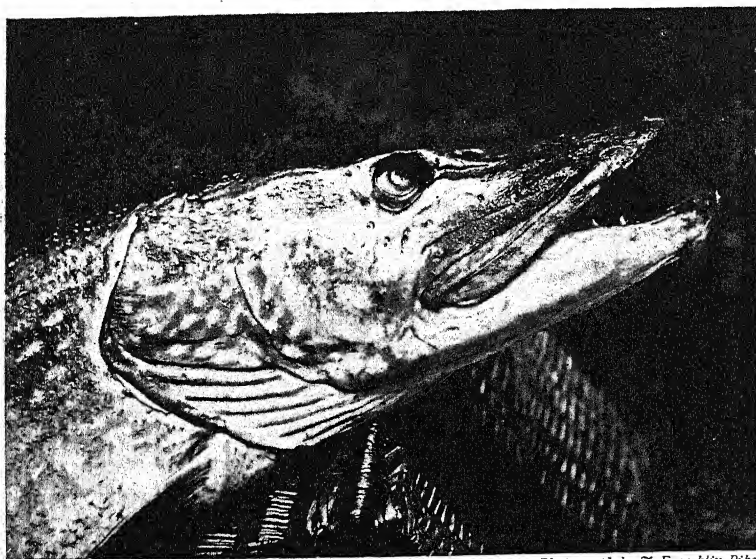
taking of Pike during the breeding season is considered an infraction of fishery laws, and an unsportsmanlike misdemeanour in all waters that are not sacred to the salmon and trout.

The Pike is of the family of the *Esocidæ*, and its scientific name is *Esox Lucius*. From Lucius, the old name of the fish, the

spawning. They resort to quiet, reedy backwaters, tributaries, and dykes.

Young Pike of a few inches in length soon begin to prey upon the fry of other fish, and where food is plentiful they grow rapidly. "The tyrant of the flood," as Pope calls the Pike, attains a great weight in some waters; and the literature

of angling abounds with accounts of monsters captured from the rivers of Eastern England, from Scottish lochs and Irish loughs. In Wales, fish of this species are rarely taken over fifteen pounds in weight; but such are found in a few lakes, in parts of the Dee, and in private ponds. Pike are not indigenous in Welsh waters.



Photograph by J. Franklin Pike.

HEAD OF A PIKE, 28½ LBS., CAUGHT IN THE SEVERN, MARCH, 1907.

Luce, used by Walton and other writers, was no doubt derived. In the South of England the fish goes by the name of Jack, and in Scotland it is the Pick or Gade. It may be noted that Shakespeare does not use the ancient name of Luce, for he makes Falstaff say: "If the young dace be a bait for the old pike, I see no reason, in the law of Nature, but I may snap at him."

The pairing season of Pike is in February and they spawn in March and April. In former times it was believed by several writers on fish that Pike were the product of spontaneous generation. Izaak Walton seems to have credited this fable, when he remarked: "'Tis not to be doubted but that they are bred, some by generation, and some not." That Pike pair and reproduce themselves after the manner of other fresh-water fish does not need assertion. In early spring the sexes may be seen in company, selecting places for

ably introduced into Bala Lake some centuries ago, and the mere is now plentifully stocked with them. A specimen of twenty-five pounds has been recorded as caught from this lake. Indirectly, I was the means of providing a nineteen-pound Pike for a Bala fisherman. While trout fishing, I was accosted by a gypsy lad, who said that he had seen a big Pike, and wished to obtain a bait with which to fish for the giant. He was without any small hooks, so I gave him some, and he took a Perch of about a pound, on a worm. With the Perch he fished for the Pike, and brought it to the bank soon after I left the lake.

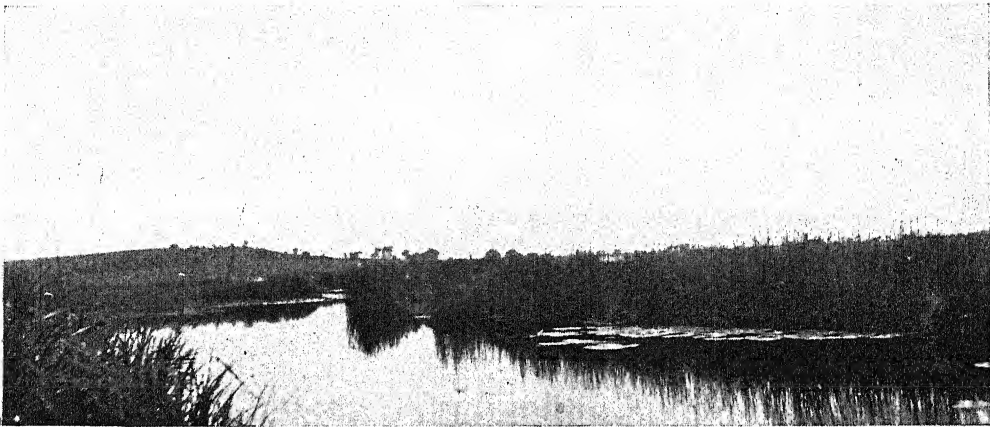
A twenty-pound Pike is esteemed a prize among anglers, but fish of over twice that weight have been captured in British waters. A writer with the pseudonym of "Ephemera," i.e. Edward Fitzgibbon, says: "I believe the largest Pike ever caught in the British Isles was that caught

many years ago, the weight of which was about ninety-two pounds, in the river Shannon, by some visitors at Portumna Castle, the family seat of the Marquis of Clanricarde."

The biggest Pike that I have ever handled was one of sixteen and a half pounds which I gaffed for my cousin, Mr. C. W. Pike, from a pool in Worcestershire; while my own "record" Pike weighed ten and a half pounds, and was caught from the Dee above Corwen. In the Thames and

sharp teeth, and the throat is capacious. Adapted in colour to its surroundings, a Pike will lie among the weeds of a stream without attracting the eyes of the passer-by. But those accustomed to watching fish can often detect a lurking Pike, lying motionless as a log, near the bank.

Except when impelled to range by hunger, or when in search of a mate, Pike resort to the cover of weeds or haunt the deepest pools. In the Norfolk Broads they enter the dense beds of reeds sur-



WHERE PIKE FEED: EVENING.

Kennet I have seen Pike of quite twenty pounds weight, basking near the surface of the water in the early summer; and when skating upon very transparent ice, on a lake in Berkshire, I saw an enormous Pike, carrying in its jaws a fish of its own species, weighing about five pounds. The Pike was so encumbered by its victim that it could only swim with difficulty. Edward Jesse relates that a keeper in Richmond Park sent him a Pike of about seven pounds, which had died through endeavouring to swallow a Pike almost as big as itself. It is said that these fierce and rapacious fish will attack a dog when swimming, and there are one or two instances of Pike biting the legs of boys while bathing.

A glance at the illustration of the head of a Pike on the opposite page will show with what a powerful jaw and huge mouth the fish is provided. The head is cruel and sinister, the jaws armed with many

rounding the water, and remain there in close hiding. Anglers sometimes expel them by means of dogs before fishing for them in the open water.

Pike are not sociable fish, and Walton describes them as "solitary" and "melancholy." They select feeding-places, and guard them jealously from other Pike. In streams they often make excursions, especially towards evening, into the shallows, where they pursue small fish. When a Pike is questing for food, its whereabouts is frequently marked by a swirl or a splash of the water, and the leaping of the dace and bleak, upon which it has murderous designs.

When rivers are ill-provided with harbours among weeds, Pike usually haunt the deep water; but they will lie in a foot or two of water if there is ample cover. They dart at a passing fish, seize it crosswise, and hold it for a time before swallowing it. In the old days of "gorge



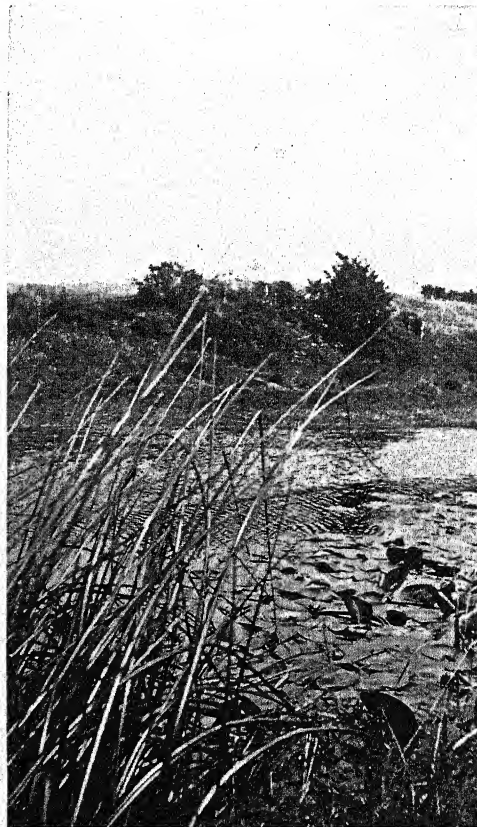
PERCH FISHING IN THE WEY.

fishing," anglers used to give Pike from five to ten minutes before "striking" the fish; but in the modern mode of fishing with snap-tackle, the Pike is struck a few seconds after taking a live bait.

Pike appear to feed greedily at times, and then to fast for a day or two. Frost sharpens their appetite, and they are very hungry after the spring spawning period, when they return to the main river, lean, dull in colour, and unfit for the table. The rapacity of the Pike is well expressed by the Welsh name of the fish, *Blaid y Dwr*, the Water-Wolf.

The Perch is one of the handsomest of our river fish, and has the merit of being good as a dish, especially when bred in clear waters and nourished upon a fish diet. It is easily recognised, even in the water, by its broad black bands on the sides, the bright red of its fins, and the big dorsal fin with its sharp spikes. Perch are often said to be excluded from the diet of Pike, on account of the danger of the dorsal spines; but this is a mis-statement, for Pike prey upon Perch, large and small, and even prefer them to other fish.

The Perch loves weedy corners, banks of clay, the neighbourhood of old piles and stumps, the roots of willows below the water, and beds of water-lilies. They are not altogether averse to saltish water, and they thrive in lakes and ponds as well as in rivers. In the Thames these fish are becoming scarcer, and two causes are given for their decrease. The first is the wastage of spawn through the washing of steam and electric launches. Perch deposit the ova on the roots of trees and upon reeds, and the violent agitation of the water by the screws of motor boats washes the spawn away and destroys it. The other factor in lessening the numbers of Thames Perch is the increase of swans and various water birds that devour the eggs. Fortunately, the owners of the swans have now consented to restrain them during the Perch breeding season, and it is hoped that

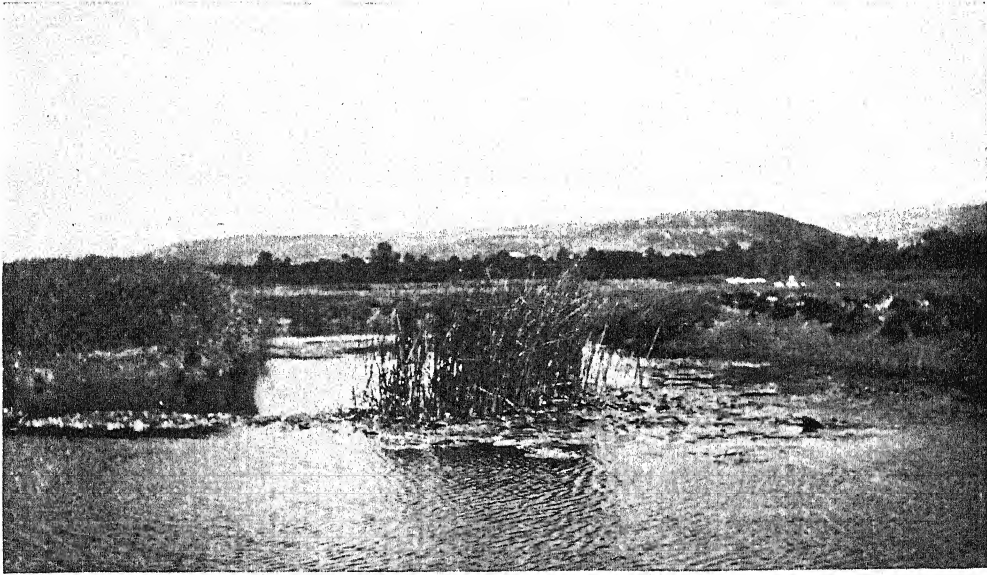


A PERCH POND.

the stock of these fish will increase in a few years.

Unlike the Pike, the habits of Perch are gregarious. They swim in shoals, the bigger fish keeping company with Perch of about a similar size. Now and again, I have chanced upon a company of large Perch while fishing in rivers and lakes, and the sport has been fast and furious. But in some big rivers it is not always easy

of over three pounds is considered a very good fish. Five pounds is stated to be the record weight of the Perch of Bala Lake, and from Norfolk waters fish of this species have been secured up to four and a half pounds. Jesse states that a Perch of five pounds ten ounces was caught in the Colne. On the authority of Thomas Pennant, whose "British Zoology" was completed in 1770, a Perch of



A HAUNT OF PERCH.

to locate the fish, and the angler has often to roam far before he comes upon a shoal. On the other hand, there are waters wherein Perch swarm, where they may be captured almost anywhere, though in such cases the fish are generally small.

Perch are fairly distributed throughout our islands. They inhabit waters in the North of Scotland, and many rivers and meres in England, and they are found in some of the Welsh lakes among the mountains, such as Llyn Arenig, many hundred feet above the level of the sea. Perch grow to a fair size in the Loddon—a Thames tributary; in the Wey, the Lea, some of the Sussex streams, and in the rivers and broads of Eastern England some heavy examples have been caught. Mr. F. G. Aflalo mentions seven to eight pounds as a maximum weight for Perch, but a specimen

nine pounds has been taken from the Serpentine in Hyde Park.

I have caught Perch of two and a half and three pounds from a private lake, and specimens of about two ounces from the Chelmer, and an overstocked pond in South Wales, where the fish literally swarmed. This difference in weight is to be explained by the liberal food supply in the lake, and the fact that the numbers of Perch were kept down by Pike; whereas in the Chelmer and in the pond in Wales, the Perch were poorly fed, and but little exposed to the depredations of Pike and other enemies.

Perch like a sandy bottom, and in the Norfolk rivers they are found in shoals wherever the sluggish stream flows over a bed of sand. They are equally fond of weedy waters, but do not, as a rule, con-

gregate in swift-flowing currents. The mouths of dykes are favourite haunts, and in lakes that contain trout one may see the Perch waiting in companies for the small trout fry, as they leave the hatching places and venture into the lake.

The larvæ of insects, fresh-water shrimps, shellfish, and earthworms are the food of Perch, and they feed freely upon minnows, young gudgeon, and the fry of several fish. It is an interesting instance of the fierce struggle for existence below the water, when a big Perch, with his back fin erect, and the bronze and green of his scales glowing, dashes into a shoal of minnows in the shallow water, driving the frightened fish in all directions, and causing them to leap in the air to escape the open jaws. A Perch of a pound in weight will seize a gudgeon of four to five inches in length. They often take an angler's spoon-bait when he is spinning for Pike. In some ponds Perch will dart at an artificial fly, sunk and jerked through the water, doubtless mistaking it for a small fish or an aquatic insect. They may be attracted to the fishing ground by worms thrown in over-night, and by stirring up the mud and gravel with a rake at the time of angling for them.

Perch are bolder than most fresh-water fish. Where they abound, it is not difficult to see them, unless the water be discoloured, and by approaching the riverside quietly a glimpse may often be caught of a large Perch or two, or a shoal of small ones, swimming sedately on the fringe of the weeds. In navigable rivers and canals they may be detected close to lock gates and the boardings, or "camp-sheddings" of weirs, while in ponds, on a bright day, their black bands and red fins are frequently visible amid the stems of water-lilies. The temerity of the Perch makes it a favourite among juvenile anglers. Perch are not easily scared, like roach, by

coarse tackle, nevertheless, fine methods must be employed for the capture of the Perch of over-fished rivers like the Thames and Lea. Hungry, undersized Perch in quiet ponds and crowded, undisturbed streams take a bait with fierce avidity, and may be pulled out by the score. Bigger Perch are naturally more suspicious, yet there are occasions when they feed recklessly for a spell, and then suddenly grow alarmed and swim away.

William Harrison, in "Holinshed's Chronicles," refers to Perch as protected fish during the Elizabethan period, stating that these, among other fresh-water fish, were preserved during the spawning season "by very sharp laws, not only in our rivers, but also in splashes or lakes and ponds, which otherwise would bring small profit to the owners."

There are old stories of the medicinal value of a stone said to exist in the brain of Perch, and there is no doubt that our ancestors believed in the curative value of the flesh of Perch, which was recommended by physicians to wounded patients and persons in fevers. In ancient Germany, the Perch of the Rhine were esteemed as remarkably wholesome.

By our present fishery laws Perch are protected from March 15th to June 15th. They spawn from April till the end of May, and are not in good condition until August. George Rooper, author of "Thames and Tweed," states that nearly all the Perch he has caught and examined were females, and that at all seasons of the year he has found the spawn fully developed. This is a matter which seems to have escaped the attention of naturalists, and the discovery may help to explain the reduction in the numbers of Thames Perch; for if the majority of Perch taken from the river are females, the balance of the sexes is probably seriously disturbed.

WALTER M. GALLICHAN.



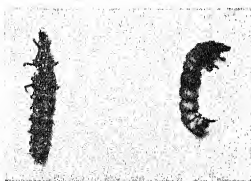


SOME OF THE CASES MADE BY CADDIS-WORMS.
(Natural size.)

STONE-TURNING—II

By R. A. STAIG

Illustrated from Original Photographs by JOHN A. BALLANTYNE



CADDIS-WORMS.
(Natural size.)

MAY is a good month for stone-turning in the shallows of our streams and hill burns; but almost any day from early spring to late summer numbers of aquatic larvæ and other forms of animal life may be found concealed beneath the submersed stones, and upon the under surfaces. The latter is a favourite situation with

certain Caddis-worms. These are the larval stages of Caddis-flies, a family of small insects with robust chocolate-coloured bodies and four brown delicately fringed wings more or less ovate in shape. They are often mistaken for moths.

The Caddis-worm, when it comes out of the egg, sets to work to make a protective case within which it lives. It uses various materials for this purpose: sand, tiny pebbles, chips of wood, nibblings of leaves, bits of grass, and even minute snail shells, with their owners inside, whether they like it or not. The skill shown in the construction of some of these



A CADDIS-CASE MADE FROM BITS OF WOOD; AND TWO CASES SHOWING THE ENTRANCES.
(Natural size.)

Caddis dwellings is remarkable. Whatever shape or appearance the structure may have outside, it is invariably tubular inside and comfortably lined with silk; and, though usually just wide enough to admit the creature's body, many are made sufficiently roomy so that our caterpillar-like friend, when he gets tired of looking out at one end of his tube, may turn about and have a look out at the other.

The photograph on page 571 of a group of Caddis-cases found fastened at their ends to the under-side of a stone in a rapid running stream shows very clearly a few of the varied formations of these objects. The four smallest have been made from bits of rushes cut in exact but gradually diminishing sizes, and glued together in fours so as to produce a rectangular and tapering effect. A crude construction is the isolated example above the set of five, which have been built with minute stones of approximate size. More elegant are the horn-shaped forms composed of

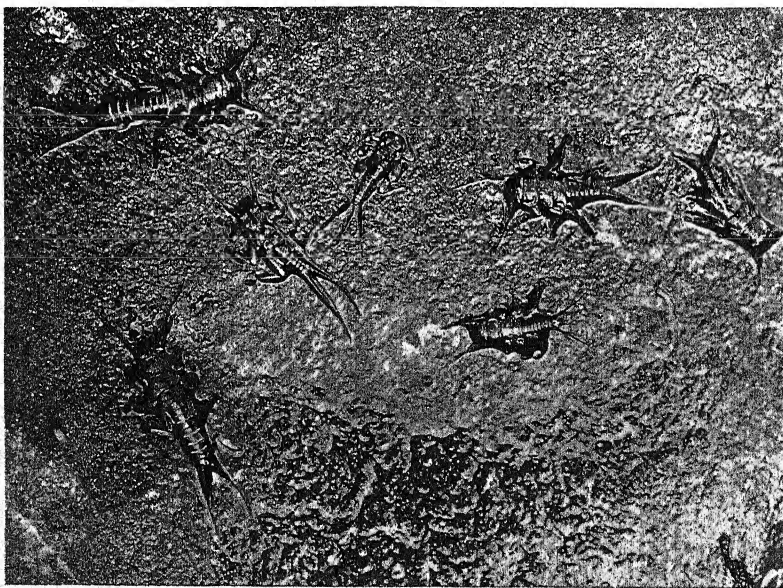
particles of sand and grit, so equal in size and so neatly cemented together that it is difficult to believe these to be the workmanship of mere grubs.

Many Caddis-worms do not moor their cases to stones but carry these temporary habitations about with them; and we frequently notice a

very regularly built case with a small stone or a seemingly superfluous length of stick attached to one end. The small stone counteracts the buoyancy of a light case, and the long stick lessens the difficulties of a fat Caddis walking under water with a heavy one.

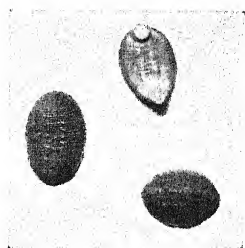
Looking again at the horn-shaped cases, we see that three of them have their entrances closed. When the Caddis-worm is about to change into a nymph it spins a web across each end of the tube, and certain species add a stone. In the photograph a case is shown with the side removed, thus exposing the nymph or pupa enveloped in an oval covering.

Very likely the next stone we turn over



"CREEPERS" ON THE UNDER SURFACE OF A WET STONE; AND A MAY-FLY LARVA.
(Natural size.)

has a "creeper" or two upon it, and several Ephemerid or May-fly larvæ. The stout "creepers" are, as a rule, less

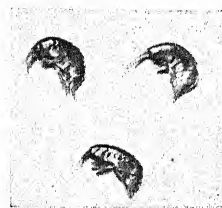


FRESH-WATER LEECHES.
One turned upon its back
to show the suckers.
(Natural size.)

than an inch in length and readily detected while trying to waggle quickly out of sight; but we may have to look two or three times for the Ephemerid larvæ, as they often remain squat and still; and so perfectly do their colours blend with the

green and brown hues of the wet stone, that one is apt, at a first glance, to pass them over unnoticed. The body of the "creeper" is divided up like that of a Centipede; but the head is big and flat, and almost as broad as the first three body segments, which have flat horny shields like half moons, and which are very much wider than the others behind. The eyes are prominent, and the head has two long sensory feelers. A similar pair of thread-like tactile processes project from the end of the body.

The "creeper" swims well; its three pairs of legs are noticeably fringed with swimming hairs. Put a "creeper" into water and you will see little bunches of fine filaments on the sides of its body.



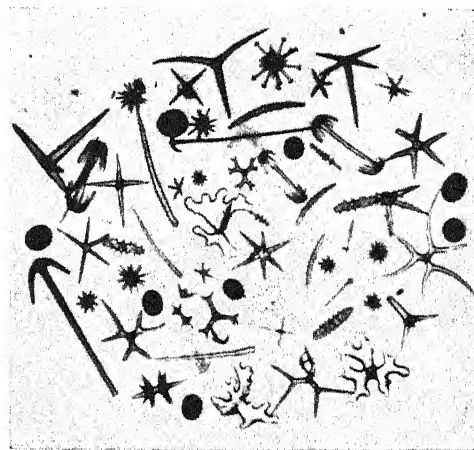
FRESH-WATER SHRIMPS.
(Natural size.)

The Caddis-worm and the May-fly larva have, in the same position, somewhat similar structures. Breathing organs these are, connected to the air-tubes which ramify throughout every part of the body, conveying fresh oxygen to the tissues and taking away the impure gases.

All insects breathe by air-tubes, or tracheæ, as they are technically termed; but in the terrestrial forms the air-tubes are in direct communication with the

outside air through little openings at the sides of the body. The contained air gives these fine, thread-like, respiratory tubes a beautiful silvery appearance.

Perla, the Stone-fly, which the "creeper" ultimately becomes, does not differ greatly in appearance from the Caddis insect except that it is larger, and closes its wings flat upon the back when about to rest, whereas the Caddis-fly holds them pressed against its sides.



VARIOUS FORMS OF SPONGE SPICULES.
(Magnified forty diameters.)

It is a queer trout that will not rise to a "creeper."

And what is the tough, oval, fleshy thing still sticking to the wet stone? A fresh-water Leech. Such an odd way it moves, fixing first one end, and then looping itself up to fasten the other end close behind where it fixed the first one. It stretches out like a worm, which indeed it is, a kind with two suckers, one at either end of the body.

A closer inspection of the wet surface of the stone reveals a number of tiny objects, like very young caterpillars, sliding along and bending their bodies into so many letters U. They are the larval stages of a common midge. Unless it be the small amphibious (Limnæa) Snail, which we see in clusters upon almost every stone, there is no more familiar denizen of our running waters than the little fresh-water shrimp, Gammarus; the creature with the compressed, cres-

centic body and the sidling gait, a scavenger of the stream.

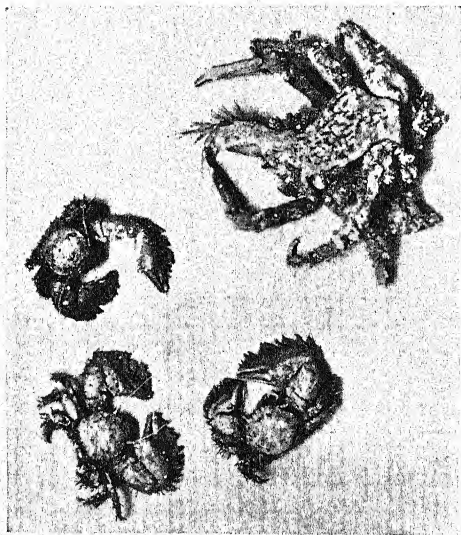
But the shore is the El Dorado of the stone-turning enthusiast. There are few



THE HETERONEREIS FORM OF NEREIS.
(Magnified five diameters.)

localities which afford such a wealth of varied life.

Any casual observer who happened to find a spread of sponge coating the under side of a weed-clustered rock at low-water mark would probably at once suppose the pulpy, greenish-grey mass to be some sort of vegetable growth. There is certainly nothing about its external appearance suggestive of an animal nature. It is a highly irregular growth



PORCELLANA CRABS AND A MASKED
CRAB (PISA).
(About half the natural size.)

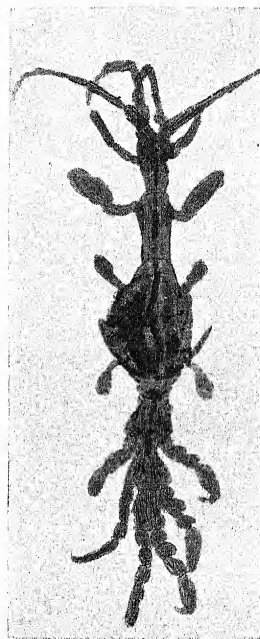
full of minute pores, and with raised portions here and there like volcano craters in miniature. If, however, a section through it be examined under the microscope one is surprised to find that what we call the Crumb-of-Bread

sponge, *Halichondria*, is in reality a city of waterways, the inhabitants all living very close together. These most minute beings are simple specks of living matter with controlling centres. Those that live along the margins of the waterways have fine hairs, or flagella, which they constantly wave to and fro to keep up the water currents, and thus ensure proper aeration and regular supplies of food.

The business of others is to flow out their bodily substance in long "arms," and enclasp passing food particles for the support of the colony; and some manufacture wonderful little needles or spicules of silica for strengthening the walls of their city. The Sponge colony shows us not only division of labour, but also how the higher many-celled animals came to be evolved.

Various species of a common genus of marine worms, known as Nereis, are abundant under stones in sand and mud between tide-marks. They are usually dark green in colour, and their bodies are much segmented. The photograph shows one which leads a double life, appearing in two distinct phases during the course of its existence; first as a Nereis and latterly as a Heteronereis, with one half of the body completely changed.

A small reddish crab, not generally known, but common enough in the crannies and crevices among stones, especially in mud, is *Porcellana platycheles*. His back is flat and so are his large



CAPRELLA, THE "NO-BODY" CRAB.
(Magnified twelve diameters.)

densely fringed claws, which, when folded inwards, fit neatly into the margin of his shell. His larger sized relative, the Common Shore Crab, sometimes provides us with an interesting case of degeneration. It is nothing unusual to find one of these crabs with a prominent rounded growth rooted under the body. This is actually a parasitic relation, called *Sacculina*, who began life as a free-swimming and promiseful larva, but who ultimately settled upon the hapless crab, first within its body and finally beneath its tail, to lead a life of ease, without eyes, without limbs, and without "nerves," but with a capacity for absorbing nourishment at the expense of its host.

Certain kinds of crabs dress themselves up for protection. A perfect example of this is *Pisa*, the masked crab shown in the photograph. It has a zoophyte growing out over its snout and a living compound of tunicates spread

upon its back, besides a thin coating of sponge around its thighs, and sundry objects on other parts of its body. These are actually planted by the crab itself, which has hooked hairs all over its shell for holding securely the various articles of clothing, animate and inanimate.

If we look carefully among the finer seaweeds under the stones in the rock-pools we may come across that grotesque creation, the "No-body" Crab, *Caprella*, clinging to the weed with its small legs, and swinging about its thin body and large arm claws mesmeric fashion.

At the shore or in the country, whether it be in water or out of it, almost any stone we choose to turn over will provide us with some natural object worthy of our attention, something worth carrying home to have a better look at, no matter how small or insignificant it may seem.

R. A. STAIG.

THE HILL GRASSES

By MAUD U. CLARKE

With Photographs by HENRY IRVING

IN regions as remote from each other as are the high lands from the marshy flats, we find the grass making proportionate modifications of form.

Every sappy particle, expressive of a plant that absorbs abundant moisture, is dried and shrunk into contracted fibre, and consequently contracted bulk of form, in the grass of the high land. The sum total of the plant's days is spent in ceaseless rush of wind and beneath unsheltered glare of light and heat. There must be an equally unceasing effort to maintain the supply for so great a toll on the part of the grass. In every fine, sharply pointed blade of the hill grasses, there is the expression of tense energy, in strong contrast to the loose lush fibre of the water grasses. Millions of rounded blades have been fashioned as

bayonets by sheer response of effort to meet necessity.

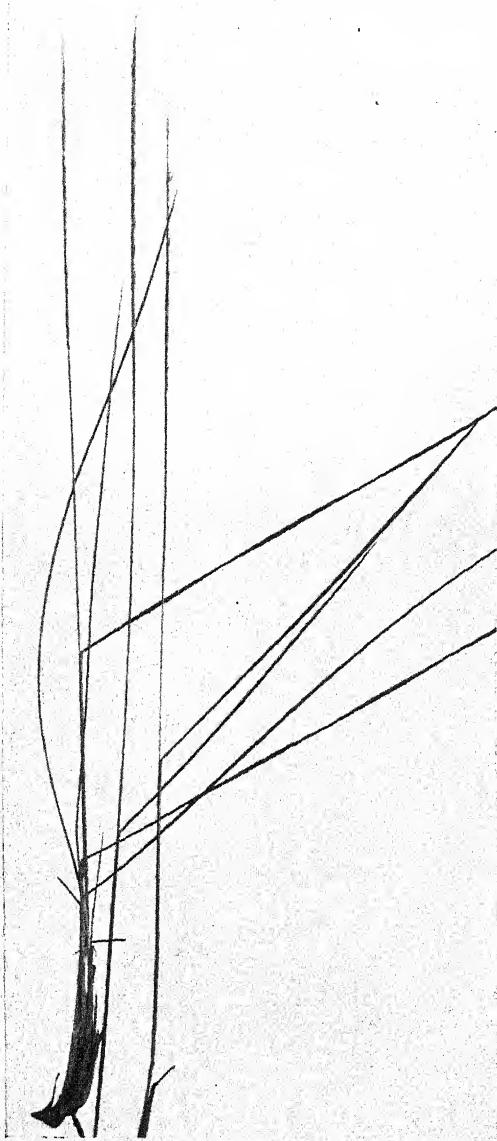
Apart from the moisture kept to a certain extent existent at the roots by the very density of the blades themselves—assisted by the valuable peaty accumulation that grass constructs just above the roots—there is no assistance given by other growths to maintain a moist temperature.

For miles and miles our downlands are devoid of any shelter of tree or shrub, and the grass that lives there meets a stern schooling when one considers that vegetation, in original principle, demanded two things for its well-being—heat and moisture. Turning for a moment from our downland to the tropical vegetation, we see it as an amazing giant, adding complexity to complexity, and growth to growth; the enormous life-forces

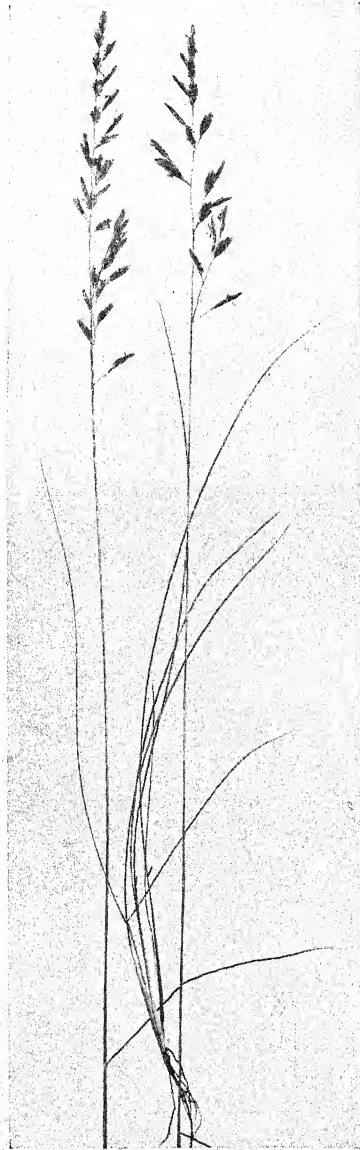
welling up in magnificent freedom unhampered of necessity.

But when we consider the hill grasses of

is that of very closely compacted cells effecting a fine presentation of the grass-scheme of stem and blade.



MAT GRASS.



SHEEP'S FESCUE.

Britain we face a wholly different order of things, yet one that is as certainly an expression of life-force which, if less ample, is surely more intense. If less superabundant, it is more vital through conflict. The actual quality of the hill grass

The broad, sedgy leaf is reduced to a minimum; the flat surface contracted to a rounded one, with its point sharpened to that of a strong bristle.

The initial characteristic of hill grass is that of fine, tough strength, and a densely

PLANT LIFE

GRASSES

Specimens required :—GRASSES IN BLOOM

Structure

TYPE.—Wild Oat Grass :—

- (a) *Roots*.—Fibrous.
- (b) *Stem*.—Note occurrence of joints (nodes). Make a section through grass, noting that stem is hollow between nodes and thus gives strength to the stem.
- (c) *Leaf*.—Note parallel venation. Observe sheathing process of leaves at base.
- (d) *Flower*.—Examine spikelet with lens.
 - 1. Outer pair of leaves : the glumes.
 - 2. Inner pair of leaves : the pales.
 - 3. Stamens.—Note number.
 - 4. Pistil with feathery stigmas.
 - 5. Awn.

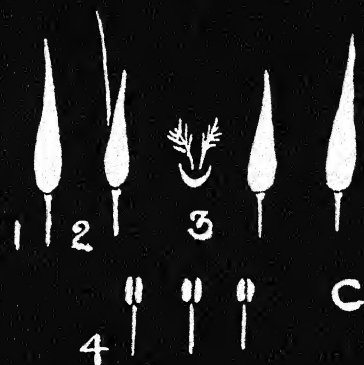
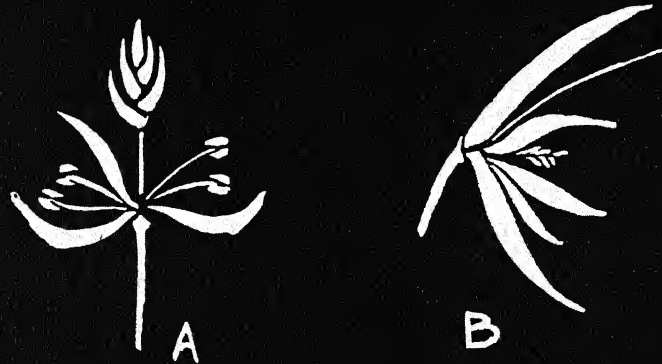
Note that glumes correspond to the sepals of a flower and that pales correspond to the petals of a flower.

Shake the head of the grass on paper, and note the yellow pollen. Pollination is effected by the wind.

Examine other kinds of grass in the same way, entering records and diagrams.

Obtain seeds of grasses and mount on cardboard with the grasses collected.

PLANT LIFE. GRASSES.



Structure

A, B - spikelets. C. 1. glume. 2. palea. 3. stigma. 4. stamens.



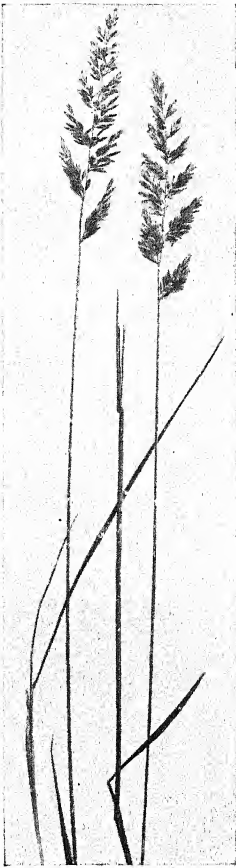
Wild
oat



Meadow
grass.



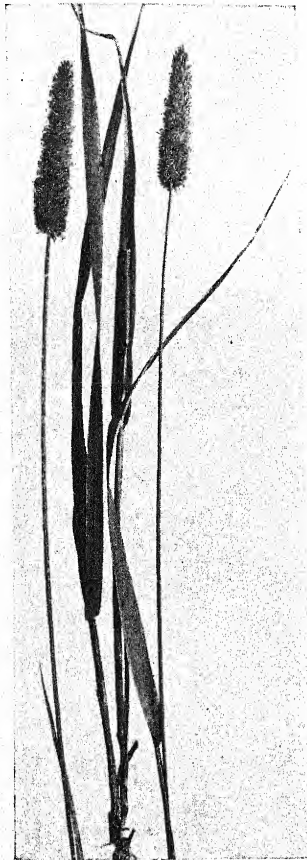
Foxtail.



CRESTED HAIR GRASS.

In both the two first illustrations we find good examples of this principle of being, that of the Mat Grass (*Nardus stricta*), and the Sheep's Fescue (*Festuca ovina*). The flowering heads of the former grass are, however, shown at almost too early a stage to be easily recognisable; the glumes lying very flatly upon the upper portion of the three stems. The formation of the flower-scheme in this species differs from that of those previously treated, since there are no empty glumes in the spikelets; they are absent, leaving only the true flowering glume, which is shortly awned, bearing the stamens and a one-styled carpel. It

tufting habit of growth, as if the life-force were expanded in adding density of compacted blades rather than the liberal expansion of individual ones.



MOUNTAIN CATS-TAIL.

is a common heath grass, the spikelets showing a reddish or purple colour, and standing rather far apart in the notches of the stem. The upper, and lowest blades that fall at right angles across the picture, distinctly show a twisting of the blades upon themselves. To be dogmatic on any such subtleties of growth in plants would be rash, but I would venture to suggest that this twisting may be caused by the unequal play of circumstances; the variations of wind-rush, and consequently of temperature, upon the extending purpose of the blade. In other words, it is one more brand mark of the plant's surrender to check, yet eventual return to its original expression or purpose.



ALPINE MEADOW GRASS.

The portion of the rootstock, showing at the base of the left-hand flowering stem, illustrates the strong tuft-

ing nature of this grass. Securely enveloped in the sheathing membrane, immature blades of several lengths are shown packed one upon the other. They are glabrous in type, that is, non-hairy, and purely green in colour.

In contradistinction, the Sheep's Fescue is glaucous, having a grey bloom on blades that are almost cylindrical in form. It is also a strongly tufting grass, varying from an inch or two to twenty-four; the flower stem is a four-angled construction supporting a purple panicle of perhaps four inches in length. The spikelets are small, and the glumes show little, if any, of the hair-like awns.

It is one of our commonest grasses on the dry uplands, and, like the Mat Grass, is perennial in root-stock, flowering through June and July. Compared with the finely attenuated blades, the flowering head is a strong construction showing some breadth of development.

Koeleria cristata, the Crested Hair Grass, although a grass of short growth associated with high dry pastures, is far less typical than those species already mentioned. For the surface is downy, although the flowering glumes are membranous, green and white in colouring, and have a silvery sheen upon them. The shortened growth of twelve inches proclaims the grass of dry quarters, yet the stout stem and solid nodes, together with the broadened blade, expresses relationship with the grass of the valleys. The spike may vary from one inch to four inches; when meeting the diminutive example we more easily recognise the plant contracted by its situation, and forming the distinct species.

A still stronger departure from the contracted type of hill grass is the Mountain

Cats-tail (*Phleum alpinum*). It is an admirable instance of Nature's apparent extreme objection to be regulated, even by principles of growth, according to circumstance. Exactly when you have made elaborate definitions and classifica-

tions concerning species, and founded general rules concerning them—as taught by themselves, moreover—just then an individual, or a species, wriggles from precise grasp and escapes by the back door, to be and grow as it likes, and where it likes. And our part is then to observe these facts, and reflect upon them, always recollecting that Nature is both extremely flexible and extremely self-willed—for all said and done, the acceptance of modification is only the determination to persist turned inside out.

The Mountain Cats-tail, living high up in the world, in stature anything from six inches to eighteen, is, after all, our old friend the Timothy Grass of the meadows.

Although botanically classed as a separate species, one must not forget that this is an entirely fictitious arrangement of man's making, and inherently none of the plant's own. For we see in

this mountain variety the same inflated leaf-sheath and broad blade that possess a certain resemblance to the Reed. Indeed, the term *Phleum*, coming from the Greek word *phleos*, a reed-like plant, is very suggestive that apart from our own shores this grass may be very much more reed-like.

There is little of the attenuated character about it, although there is reduction in actual height. Sometimes, this species is the water-loving one, even at a high altitude, as it is found on the edges of mountain springs. The purple spike,



DOWNY OAT.

of an inch long, has the glumes awned, forming something of a bristly head. It is a perennial plant, but flowers, however, only in July.

In a previous article on the Hay-field Grasses, mention was made of *Poa Annua*, the Annual Meadow Grass, there was, however, no illustration of it. Of the same family, but distinct in appearance, is the Alpine Meadow Grass, *Poa Alpina*. It is a tufted species found in high mountain districts, and has rather short, broad leaves, bluntly tipped. The stem growth is somewhat bent at the base—an emergence from the creeping habit of growth towards the vertical, and common to many varieties—with a leaf-sheath swollen at the juncture with the root. In *Poa Annua* we are familiar with the obviously triangular shape of the flower panicle, a three-inch of height equalled by its breadth, the glumes a clear bright green. But in *Poa Alpina*, a perennial species, there is a departure in form to a more elongated panicle, which branches into pairs of spikelets from the stem. In the right-hand stem of the illustration, that is shortened above the node, the rounded character of the blade is well shown, how the edges re-curve upon itself the whole length from the juncture with the ligule to the blunted tip. In the central example of the group the tufted growth is also exhibited, a series of blades springing out all round the lower portion of the most interior blade during its upward growth.

The Downy Oat belongs to the high, chalky land, although it attains two feet of growth. *Avena pubescens* at once

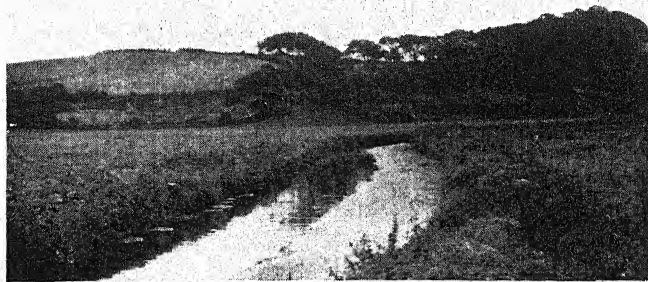
reminds us of the Common False Oat, previously mentioned, although the latter is botanically removed from the family of *Avena*, save in the sub-title of *Avenaceum*. Comparing the two, we notice that the flowering spike is more contracted, a simpler arrangement, save in the lower group of branchlets, as illustrated in the right-hand specimen of the two; much of the upper length expresses the glumes almost without branches at all.

The radical leaves are distinctly downy, whilst the ligule is sharply pointed; this is well shown on the extreme right-hand stem of the group. The bent, twisted awn is characteristic of both these varieties.

In the illustration on the left hand of the group, we clearly see the working principle of the grass-anatomy, as one may term it—that of the outward extension from within of layers, or *laminae* of blades, superimposed upon each other. There are two sheathing layers overlying the third inner layer, or separated blade, which finally escapes into freedom as the others themselves bend outwards into freedom, afterwards aspiring to considerable height. This elaboration of layers seems to be the method of expression of the grasses' green life-spring of force always welling up from the rootstock.

In the smallest of starved grasses there is the infinite mystery of capacity for projecting one series of cells into the form of radical blades, and another into that of the complex flowering stem and all its sections; for there is no true apprehension of the matter, and the word mystery, or miracle, only is appropriate.

MAUD U. CLARKE.



HOW TO KNOW THE REPTILES

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE GRASS SNAKE

THE SMOOTH SNAKE

With Photographs by the Author

THE Grass Snake is practically unknown in Scotland. In point of distribution, therefore, the Adder must be considered the commonest serpent in Great Britain. In southern



THE GRASS SNAKE.

counties, where both Adder and Grass Snake are plentiful, I am inclined to think that the latter is actually the most numerous. He is certainly the most obvious, but this may be due to his inclination to bolt when alarmed, whereas the Adder lies low to the last, and, for this reason, must often escape notice.

As we get northward the Grass Snake tends steadily to become scarcer, and there can be little doubt that this scarcity is due to the low autumnal temperatures of the northern counties. Unlike the Adder and the rare Smooth Snake, which

produce their young in membranous envelopes which rupture at birth, the Grass Snake lays eggs which require a considerable degree of heat for incubation, and which hatch somewhat late in the

year. These eggs are usually deposited in some heap of decaying organic matter in which heat is spontaneously generated—a dung-hill, for example, or a pile of weeds; and the fact that such heaps are usually artificial accounts for the persistence with which Grass Snakes frequent the immediate neighbourhood of human habitations. They will visit the same manure heap summer after summer, and the "turning" of it in the autumn will often bring clutch after clutch of eggs to light. A single

snake probably lays three or four clutches, each of which contains about forty eggs, glued to one another by a sticky secretion, elastic to the touch when fertile, and, when about to hatch, some twenty-five millimetres long. The "shell" is a whitish membrane of the consistency of stout paper, and the young snake cuts through this by the use of a temporary horny tooth projecting from the snout.

An old female Grass Snake attains to quite formidable dimensions. I am not certain that any record of a five-foot Grass Snake in this country is indis-

THE GRASS SNAKE AND THE SMOOTH SNAKE 581

putable—a three-footer is a fine specimen—but there are plenty of certain records of Grass Snakes approaching four feet in length, and I have myself handled an amiable female of forty-four inches.

The superiority in size of the mature female over the mature male is marked, though, as is often the case with reptiles, it is the male who has the longer and more tapering tail. I remember once encountering, on the bank of a stream, what I took to be a female of a size to beat all records, and being disappointed to find that what I had imagined was her tail was, in reality, a complete suitor barely half her length.

Both our harmless snakes belong to a very large family, the *Colubridæ*, which has been arranged by Mr. Boulenger into three groups, according to the presence (or absence) and the position in the upper jaw of *grooved* teeth. The first group, the members of which have solid, grooveless teeth, embraces the sub-family of Colubrines, to which most of the snakes kept as pets by the ophiolatrous belong.

All these are perfectly harmless, in the sense that they are not venomous; but many of them bite with a will, and the

bite of a large specimen is, of course, to be avoided. The second group contains snakes which have one or more teeth in



1



2

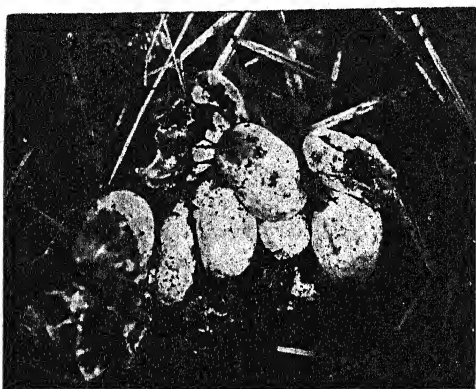
1. THE GRASS SNAKE.

2. THE SMOOTH SNAKE.

In these pictures the resemblance between the head scales should be noticed. The Smooth Snake is in the act of sloughing, and the eye-scale has already loosened, giving the eye an opaque appearance.

the back part of the upper jaw grooved. Some of these are venomous, but none is so deadly as the members of the third

group, such as the Hamadryad ("King of the Cobras"), the ordinary Cobra, and the Black Snake of Australia, which have teeth in the front part of the upper jaw grooved or perforated. The venom of the Cobra is considered to be sixteen times as powerful as that of the Adder, and it has been estimated that '015 of a gramme of its venom will kill a human being.



EGGS OF THE GRASS SNAKE.

More than a thousand species of Colubrine snakes have been distinguished.

They have, as might be expected from their multitude, a world-wide distribution (the only impassable barrier to snakes on a continent is the line of permanently frozen ground), and they include aquatic, semi-aquatic, arboreal and terrestrial species. Our own Grass Snake may be reckoned as semi-aquatic. He is, at the same time, an excellent climber. His slough is usually found a foot or so above ground level, and he runs the hedgerow in search of eggs and nestlings. Where both he and the Adder are found in the same county, it is the Grass Snake who prefers the low-lying damp situations, while the Adder is more usually in evidence on the dry heights. Where no high ground exists—as in the Fens, or the Essex marshes—the Adder frequents the highest points available—the dyke-banks, for example.

In coloration the Grass Snake may easily be distinguished even from a dingy Adder. The yellow collar round his neck, from which is derived his alternative name of "Ringed" Snake, is a distinctive character, and, so far as British Grass

Snakes are concerned, practically invariable. It is thrown into strong relief by the darkening of the scales behind it. In the newly hatched young (I may mention that Grass Snakes' eggs can easily be hatched in a hothouse where the temperature is maintained above 60° F.) the collar is of a blue-grey colour, but in a few days' time it acquires the yellow tint, and is even more conspicuous in a young, round-eyed, large-headed snake than in a mature snake. On rare occasions the blue-grey collar persists as a whitish colour in the adult.

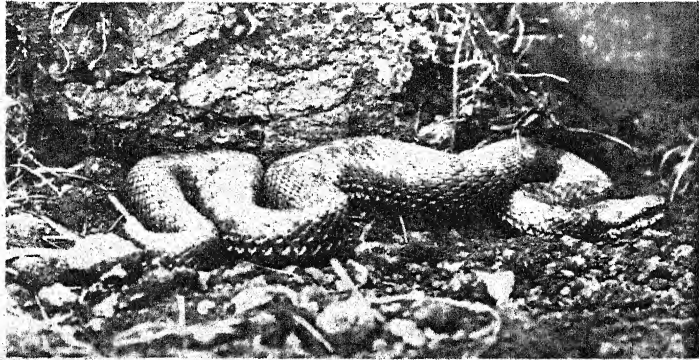
The body-colour of the young may be described as a dark green-olive. In the mature specimen it varies with the age of the skin, and, to some degree, I think, with the locality "Olive" describes it fairly enough, for the variations of tint which it displays correspond pretty closely with the variations in the dinner-table olive.

Along the Grass Snake's sides are irregular black spots, and beneath these are to be found vertical black hatchings.

The scales, compared with those of the Smooth Snake, are keeled, but their "mid-rib" is not so evident as is the case with the Adder.

A Grass Snake's food normally consists of amphibians and fish. Several instances, however, have been recorded of his swallowing mice and small birds, and there is one curious record (*Field Naturalist's Quarterly*, Nov., 1903) of his swallowing a mole.

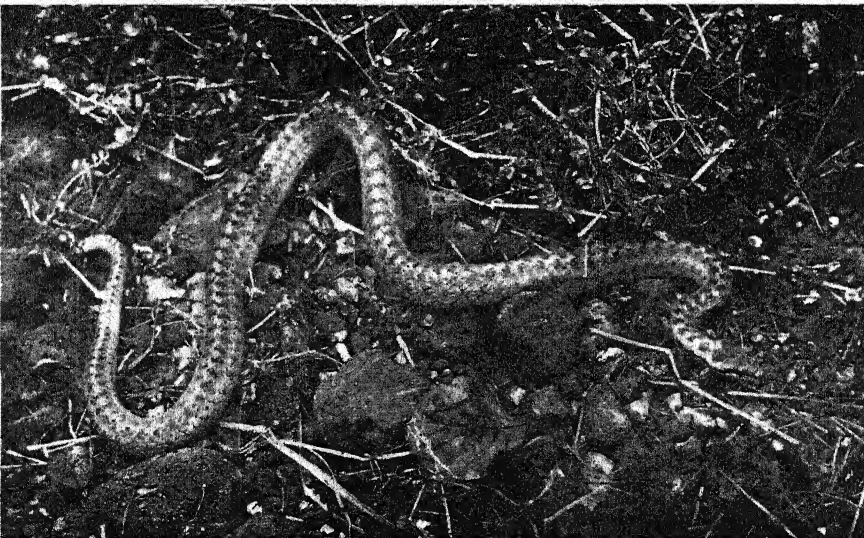
In swimming the Grass Snake holds his head six to eight inches above water, and proceeds by an eel-like undulation of the trunk and tail. To catch fish, he must, of course, plunge his head below the surface, but he follows the habit of most semi-aquatic creatures in bringing his prey ashore to eat it. This procedure is forced on him. As we have noted in the case of the Adder, a snake swallows by working himself outside his victim rather than by ingurgitation, and, to do this, he must have something solid both to push off from and to push against. The Grass Snake has no teeth to correspond with the poison fangs of the Adder, but is well provided with small teeth, having four rows in both the upper and the under jaws. All these teeth are



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2



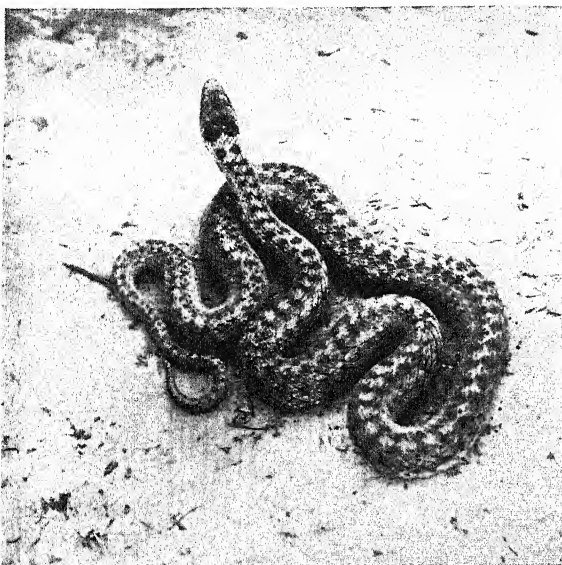
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THE THREE BRITISH SERPENTS.

1. The Adder. 2. The Grass Snake. 3. The Smooth Snake.

recurved, so that little effort is needed to shift the grip on his victims a tooth or so forward.

In the case of the gorged Adder it is usual to find that a mouse has been swallowed head first, and we may assume, in the absence of any record whatever of a mature Adder feeding naturally in



THE RARE BRITISH SMOOTH SNAKE.

The body markings should be compared with those of the Adder, and the heart-shaped V at the back of the head noticed.

captivity, that a mouse who does not present himself in a convenient "lie," is paralysed and then adjusted to suit the Adder's convenience. It must be remembered in this connection that an Adder's fangs are brittle, and need careful nursing, and that he has no "border" teeth in the upper jaw.

As far as captive Grass Snakes are concerned, I have found that a frog or newt is just as likely to be swallowed feet first as head first. This may, in part, be due to the fact that amphibian skulls are easily compressible and amphibian teeth insignificant. Generally the frog is caught by one hind-leg, which is soon joined by its fellow. The whole process is singularly horrible to watch, and I feel I need make no apology for illustrating the last phase only, though I cannot think that the frog is in any way

conscious of his predicament. I have already referred to instances of his being disgorged alive and uninjured.

A Grass Snake who is cornered, presents, if he be a sizable snake, a bold front to adversity. He hisses loudly, sometimes opens his mouth, flattens the nape of his neck, emits a singularly noisome smell, and swings himself back or sideways as though about to strike. Sometimes he actually does strike, but it is a lash rather than a lunge. The usual attack of the Python or Boa is a lash of the head and the fore-part of the body, the constricting force being held in reserve, and only employed when a serious meal is contemplated. Our Smooth Snake, who shows fight in much the same way as the Grass Snake (but emits no smell), affords a further resemblance to the older type in his habit of winding a coil of himself round his intended meal, and another coil round some fixed support.

The Smooth Snake is unquestionably scarce in this country, being confined to the heath and pine country in the south. The fact that the Sand Lizard is found in the same localities is fair presumptive evidence that Sand Lizards form part of his normal food, but it is going too far to say that they form the whole of his food. The heath and pine country has a characteristic fauna, and is especially rich in insects. From the success of the Rev. O. Pickard-Cambridge's experiment—he kept a specimen of the Smooth Snake in good order for several months by feeding it on bluebottles—we may assume that the Smooth Snake at large has a catholic taste.

In point of size (eighteen inches to two feet), and in the markings on his skin, the Smooth Snake displays a superficial resemblance to the Adder. Examination of the photographs will show, however, that his build is essentially Colubrine, and that his markings afford a distinct means of recognition.

The "V" at the back of his head is heart-shaped. Behind it come parallel

THE GRASS SNAKE AND THE SMOOTH SNAKE 585

rows of blotchings which sometimes coalesce into transverse bars, but never form a zigzag.

In a fresh skin the Smooth Snake is a very handsome reptile, his ground colour being steel-grey and his spots a darker shade of the same. It may interest those of my readers who are photographers to know that soft bromide prints from my negatives of the Smooth Snake afford a

Smooth Snake. In the Grass Snake the same head plates are contiguous, but the supra-oculars are proportionately larger, and the nasals proportionately smaller, than the supra-oculars and nasals of the Smooth Snake.

An additional distinction from the Adder is afforded by the shape of the pupil of the eye. In the Adder this is a vertical slit, in the Smooth Snake it is a circle.



A GRASS SNAKE WITH A FROG IN ITS GULLET.

The gullet extends from the ring round the snake's neck to the top of the curve in its body between the two large stones. Its enormous distension can be judged from the fact that the scales on it are separated from one another. One of the frog's fore-legs can be traced between the snake's jaws.

close approximation to natural colouring. On an old skin the markings are indistinguishable and the general tint is much browner. The head plates of the Smooth Snake, which can be well seen in the photograph on page 581, are proportionately larger than those of the Adder, and are distinguished from them by the fact that the "frontal" in the centre, the "parietals" just behind it, the "nasals" in front of it, and the "supra-oculars" on either side, have their boundaries strictly contiguous. In the Adder these pre-eminent plates are generally separated from each other by smaller ones, so that the total number of plates on the head appears to be much greater than in the

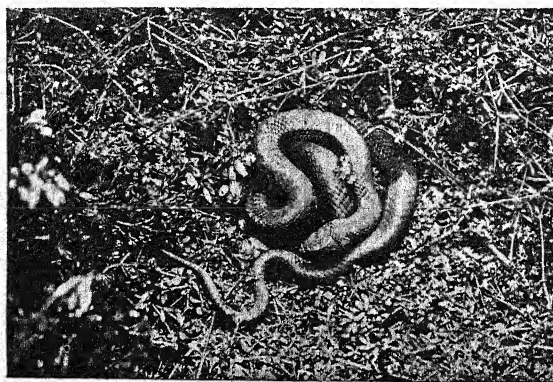
The credit of first discovering the Smooth Snake in England belongs to Mr. Frederick Bond, who secured a specimen when in company with the Rev. O. Pickard-Cambridge in June, 1853. Since that time the records have been spasmodic in character. In some years the snake appears to have been comparatively common, then a long gap ensues; then it turns up again. A correspondent writing to *Knowledge* (September 4th, 1885) refers to two in his keeping which had been captured in Suffolk. This appears to be the only instance of their occurrence outside the heath-land of Dorsetshire, Berkshire, Hampshire and Surrey.

During Professor Leighton's editorship of the *Field Naturalist's Quarterly*, several captures of the Smooth Snake were communicated to that excellent and unfortunately short-lived journal. These records can hardly be said to have widened his distribution, but they unquestionably established the fact that, if field naturalists knew where to look, and what to look for, their chances of securing a Smooth Snake were by no means so remote as had been generally supposed.

The Smooth Snake ranges over the greater part of temperate Europe. His distribution in this country finds an exact counterpart in Belgium, where he is scarce, and confined to the heath and pine districts; in these districts the Sand Lizard occurs also, and is believed to constitute his staple food. It is of interest to learn that our own Smooth Snake (*Coronella austriaca*), or some closely allied *Coronella*, is common in the island of Malta. We may reasonably assume that the "viper" mentioned in *Acts* xxviii. 3, 4 was of this species. Both the "fastening on the hand" and the emergence from a "bundle of sticks" would be characteristic, several observers having noted the tendency of the Smooth Snake to cling to anything which it has seized in its mouth, while its protective coloration and prehensile habit would account naturally enough for its being collected unawares in a bundle of firewood. Two words occur in the Greek, the first, *echidna*, being translated "viper," while the second, *therion*, is rendered

"venomous beast," "venomous" being an interpolation by the translator. It will probably surprise some proportion of my readers to learn that *therion* is the same word as our "treacle," and that "treacle" is in its origin essentially connected with snakes. For the evolution of the word (the bearing of which on the use of "adder-oil" for snake-bite will be easily recognised) I am greatly indebted to the Rev. T. Wolseley Lewis, who has permitted me to condense a communication which he made on the subject to *The Countryside* of October 26th, 1907. After referring to one of the old English versions of *Jeremiah* viii. 22—"Is there any *treacle* in Gilead?"—Mr. Lewis goes on to explain that the belief that like cures like, and that snake-bite should therefore properly be treated by a decoction of snake, was prevalent in very early times. Galen, the father of Medicine, was well acquainted with this belief, and the name of his system of pharmacy, *Theiraca*, embodies the popular idea. From *theiraca* came, by ordinary phonetic changes, *theriac*, *theiracle*, *triacle* (Chaucer), and *treacle* (Milton). First it meant decoction of snake, then any antidote, then the sweet syrup by which the taste of a nauseous drug was disguised, and, finally, syrup pure. When molasses was first introduced from the West Indies it was found a convenient vehicle for medicine, and so was entitled *treacle*; "golden syrup" is quite a latter-day refinement.

DOUGLAS ENGLISH.



A SMOOTH SNAKE
in an old skin, the markings indistinguishable.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

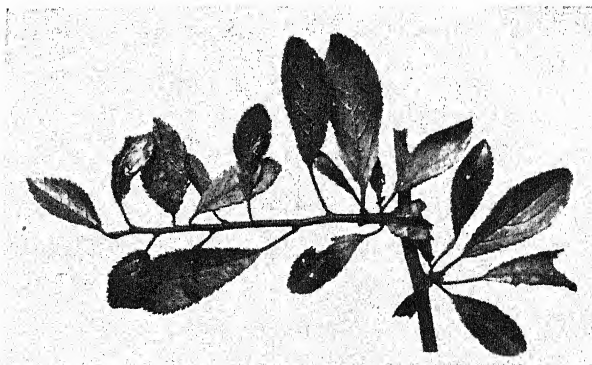
THE PLUM AND CHERRY GROUP

THIS group, and that of the Apples and Pears which follows, are classed together by botanists as belonging to the order of the Rose. The trees of this order give to our spring-time its character of luxuriant blossoming. What we should miss without their wide-flung masses of white and cream and rose, on hedgerow and by the wayside, over the broad common-land or by the woodland border, not to speak of the acres of bloom concentrated in orchards of Plum and Cherry, Apple and Pear, it were hard to say. The bounty of the autumn, too, is largely of their bestowal, in weighted branches of ranged or clustered fruits, in purple and orange, gold and ruby.

Some characteristics possessed in common by these trees may here be mentioned. Their flowers, separate or clustered, are complete, having both stamens and pistils. Bees, moths, and other insects are the agents for carrying the pollen; these flowers are therefore made conspicuous by white or tinted petals, and they are rendered especially attractive by their scent, and by their store of nectar. Their seed is produced in the form of a kernel enclosed in a hard, stony shell, or as a "pip" possessing a firm coat and enchambered in a parchment-like walled cell, the stone or pip being embedded in a mass of edible pulp. The fruit, so constituted, is rendered con-

spicuous, when ripe, by vivid colouring, and is particularly alluring to birds and animals, which are in the main the agents for its distribution.

A useful point of distinction between the two groups indicated above is found in the fact that, with the Plums and



BLACKTHORN LEAVES.

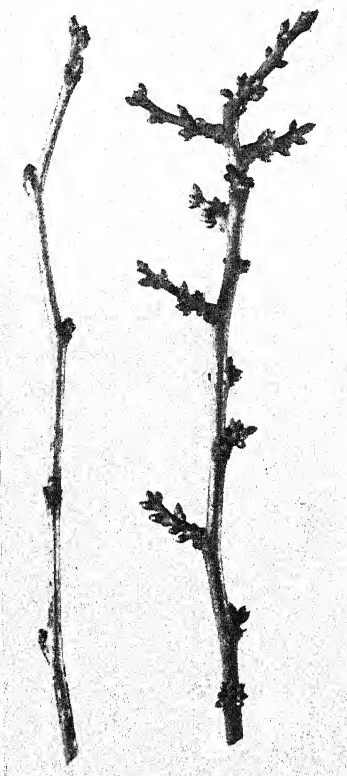
Cherries, the fruit is formed within the cup of the flower, above the green calyx, which falls with the petals; whereas the fruit of the Apple and Pear, and the trees associated with them, is formed at the top of the stalk, beneath the calyx. Here the calyx does not fall, but remains attached, in the form of a dried rosette, at the top of the fruit.

THE BLACKTHORN OR SLOE

This may rank as a small tree, but is usually a bush, and not unfrequently merely a constituent part of the hedgerow. It is most noticeable in early

spring, when its dark twigs seem almost black in contrast with the porcelain whiteness of the flowers. The chilly beauty of these, with no softening background of foliage, seen only against Blackthorn twigs, and at a time when east winds chiefly prevail, seems to lay emphasis on the harshness of this particular time of

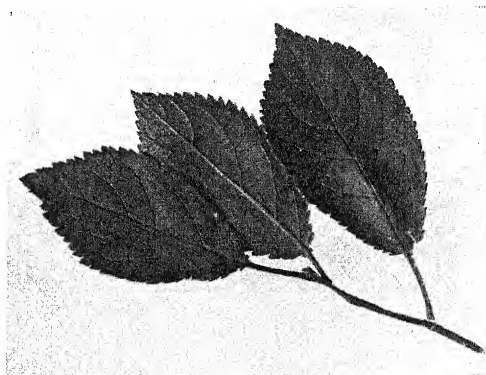
with their margins evenly and finely toothed. They have a strong midrib, but the six or eight pairs of secondary ribs are weak. The autumn colour of the leaves is yellow to reddish. The flowers grow singly on short stalks, but in close ranks, and appear before the leaves. Looked at closely, each flower is very beautiful, with its pure white petals, upholding, as it were, the central expanding tuft of stamens, each of which is topped as with gold. The fruit is nearly round, like a small black grape, but stand-



BUDS OF BLACKTHORN ON LONG SHOOT AND ON SPURS.

year, known for that reason as "the Blackthorn winter." The late P. G. Hamerton said, "a single Blackthorn can chill the edge of a forest."

The twigs are stiffly branched, and strongly armed with thorns. The buds are arranged spirally on these. They appear often in groups of three. Each little bud is rounded and blunt. The buds are crowded on the short spurs. The leaf-scar is elliptical. The leaves are oval, pointed at the base and at the tip,



LEAVES OF THE BULLACE.

ing single and erect, and covered with a waxy bloom. This bloom is easily rubbed off, and has generally disappeared by the time the fruit is ripe.

THE BULLACE

The Bullace may be regarded as a variety of the Blackthorn. The following points may be noted for comparison.

The twigs are stouter and downy. They have but few thorns. The buds are longer and pointed, downy also. The leaves are somewhat broader, with larger serrations. The larger flowers grow in pairs, and open both before and with the leaves. The fruit is more oval, larger, sometimes yellow in colour. It hangs down from the twig.

THE WILD PLUM

The Wild Plum is probably a mere escape from cultivation. The twigs are greenish to brown, and smooth. There are no thorns. The buds are large and



GEAN IN BLOOM.



BLACKTHORN IN BLOOM.

pointed. The leaves are shorter and broader, and of rougher texture. The flowers are greenish white. They grow in pairs, and appear after the leaves. The

fruit is oval in shape, pendent on longer stalk, and approximates to that growing in the orchard.

THE GEAN, OR COMMON CHERRY

Whether our thoughts run to Cherry blossom, or to "Cherries ripe," there is no question as to our interest in this tree. Mr. Meredith, thinking of the blossom, names the Wild Cherry, "Vestal of the forest."

In winter the tree shows strong, ascending branches, with erect twigs and a considerable number of dwarf shoots crowded with buds.

In spring, leaves and blossoms come out together. Viewed at a distance,

the leaves are quite hidden by the flowers, which are of a soft pearly white, and very translucent. Spenser's vision of Hope might well take form here:

"In silken samite she was light arrayd,
And her fayre lockes were woven up in gold."

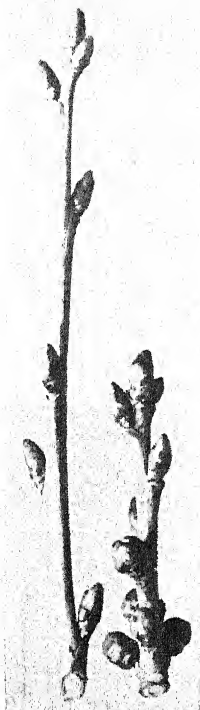
For, looked at closely, the delicate purity of the blossom is sustained by the rich, reddish brown colouring of the young leaves.

In summer the large pendent leaves, growing often in tufts, and of a fine matt green, make a strong foil for the drooping clusters of red, or red-black, fruit. But the fruit quickly disappears before the eager raids of the blackbirds.

In autumn the leaf tints are striking and varied, making a rich display, with yellow and orange, pink and red, crimson and brown, all harmoniously intermixed.

The bark is very distinctive, rough with deeply - cut downward fissures, but also showing satiny patches scored with transverse lines, after the manner of that of the Birch. These patches of bark scale off, curling up at the edges and separating along the transverse lines.

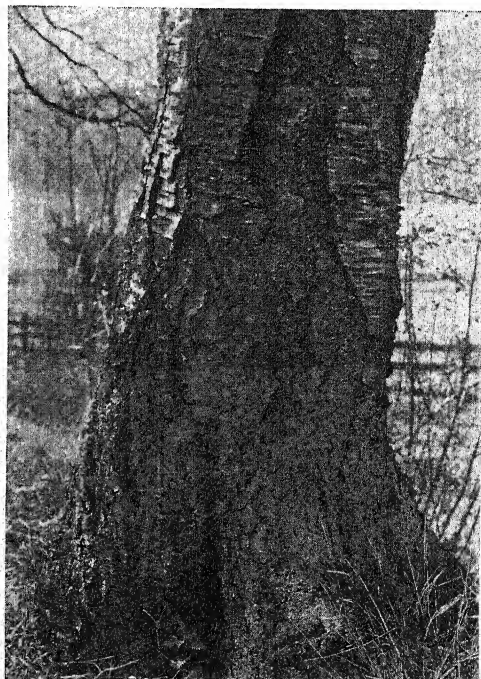
The twigs are erect and stout. The buds are large and pointed. They are brown in colour, and are protected by numerous overlapping scales. They are arranged spirally on the twig and stand upon prominent leaf bases. The flower buds are round; the leaf-scars nearly triangular. The leaves, on long stalks, hang with their points down. The margins are doubly toothed. At the top of the



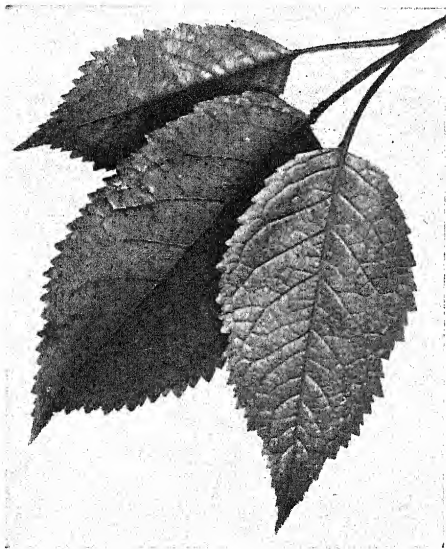
FOLIAGE AND
FLOWER BUD
OF GEAN.



BUD OF GEAN
(ENLARGED).



TRUNK AND BARK OF GEAN.



LEAVES OF GEAN.

leaf-stalk, near its junction with the leaf, are two little red glands. The flowers grow singly, each on a long stalk; a number of these stalks emanate from a single point in the twig, giving to the flowers a bunched appearance. At the base of the flower stalks are a number of membranous bracts. The fruit is heart-shaped.

This tree, like the Birch, is very subject to the diseased growth known as the Witch's Broom.

THE DWARF CHERRY

This is merely a bush or shrub. The following may be noted for comparison. The twigs are slender and drooping. The buds are smaller and blunt. The

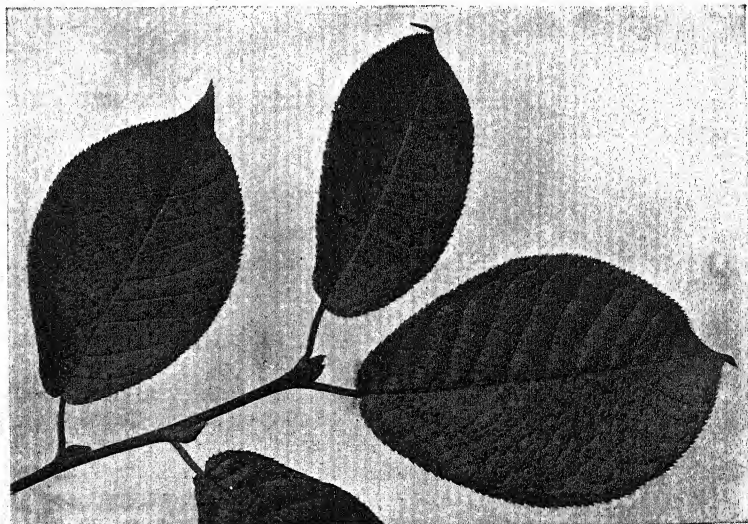
leaf-scar is half-moon shape. The leaves are not pendent, and have shorter stalks. They are harsher in texture, and their autumn colouring is less varied, being chiefly yellow and red. The flowers have harder petals. At the base of the flower stalks are some small green leaves. The fruit is globular and more juicy.

THE BIRD CHERRY

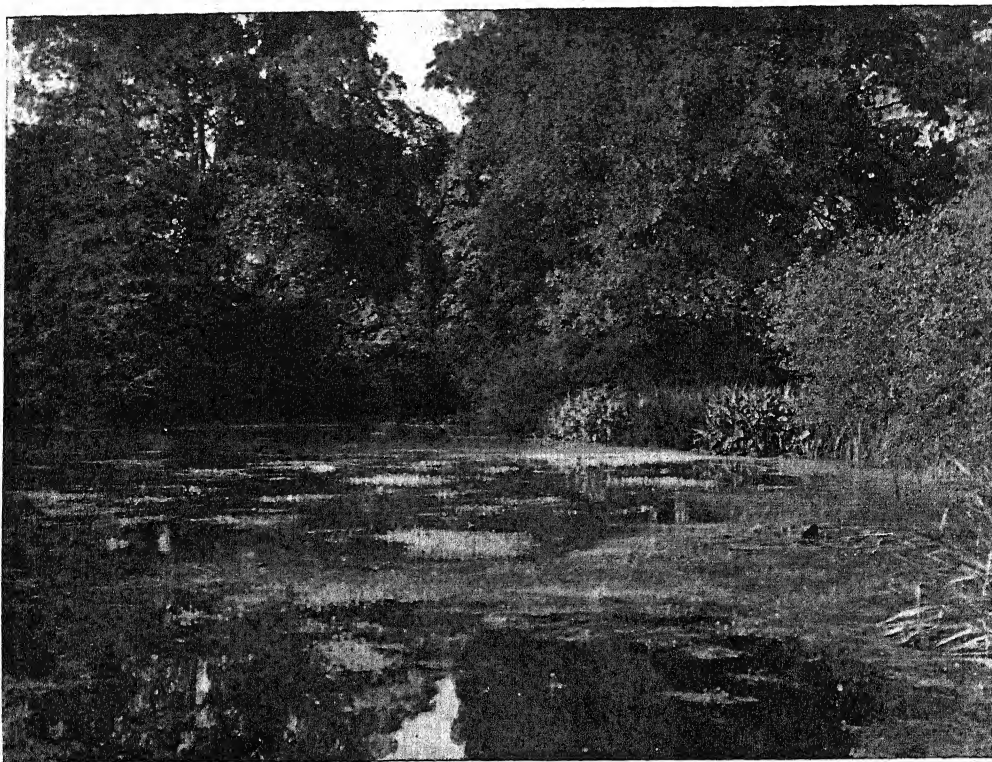
This is a small tree found chiefly in the north. The twigs are stiff and erect. The buds are large, conical, and sharply pointed. They are pressed up against the twigs, round which their points curl, suggestive of a continuous spiral. The bud scales at the base are brown, those near the tip are yellow. The leaf-scar is oval.

The leaves are broad, elliptic, having a larger side. Their surface is rough. The margins are finely toothed. In autumn the colour changes to greenish yellow and red. The flowers grow in a tasselled spray, after the manner of those of the laburnum, having a central pendent stalk, with numerous branches, to each of which a white blossom is attached. The fruit hangs by the same central stalk, and forms a cluster like a sparse bunch of small blackcurrants.

HENRY IRVING.



LEAVES OF BIRD CHERRY.



THE HAUNT OF THE DRAGON-FLY.

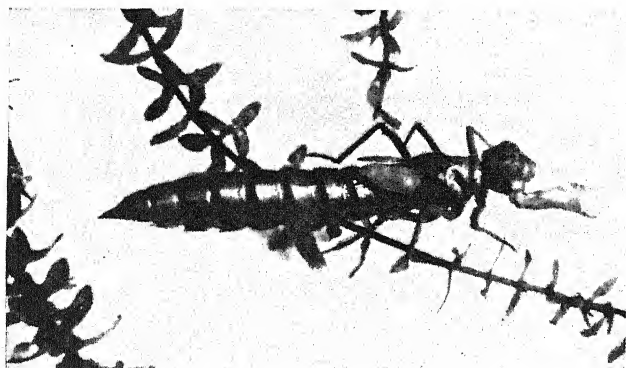
POND LIFE—I

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

DURING a long country ramble, what can be more delightful than to rest for a while beneath some graceful tree that casts its shadow upon the banks of a quiet pool? Ever and anon a gentle wind ripples the mirror-like surface of the water, and faintly sways the slender reeds that clothe the margin of the pool, making murmuring music amongst their stems, that sounds like the soft, sweet song of some graceful, slender-limbed dryad. Gradually the breeze sinks to rest, leaving the surface of the pool like a polished

mirror, in which the glorious white clouds, sweeping across the deep blue sky like stately silver galleons, are reflected. Not a ripple dimples the surface, nor breath stirs the reeds; a magic stillness broods over all. so that indeed we rest beside a silent pool, a pool that "holds as 'twere the mirror up to Nature." Even the Dragon-flies have for a brief space ceased their swift, darting flight, and rest upon an overhanging spray of foliage, their gauzy wings scintillating rainbow hues in the sunlight, their slender bodies gleaming



NYMPH OF DRAGON-FLY.

like polished turquoise. How vividly they recall Tennyson's exquisite description of their final transformation:

"To-day I saw the dragon-fly
Come from the wells where he did lie.
An inner impulse rent the veil
Of his old husk: from head to tail
Came out clear plates of sapphire mail."

* * * * *

He dried his wings: like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew."

Beautiful as is the surface of the pool, could we but plunge beneath its waters, and as we slowly sink towards the bottom, diminish in size and at the same time increase the magnifying powers of our eyes, we should indeed enter a romantic and magical world. A world peopled with the strangest forms of life, creatures at once graceful, hideous, beautiful, bizarre. Here, attached to the stem of a water weed, is a slender little tower crowned by what looks like a beautiful silver pansy, around the petals of which there is a delicate chain of hairs in constant movement. A gigantic beetle flashes past, and the silver pansy instantly disappears within the miniature tower out of harm's way. Strange-looking creatures, with cigar-shaped bodies and long, slender legs, crawl stealthily over the floor of the pond, amongst the brown leaves and mud.

Indeed it is a veritable fairyland, this world beneath the surface of our quiet pools, full of the most wonderful and varied collection of creatures and plants.

Let us examine more closely these strange cigar-shaped creatures, and see what we can find out about their life-history. They are the larvæ of the Dragon-fly, and for all their sluggish movements are amongst the most blood-

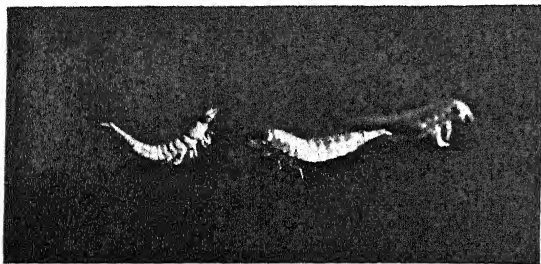
thirsty denizens of the pond. Though at the first glance they look comparatively harmless, defenceless creatures, closer inspection reveals the fact that they are armed with a powerful and most extraordinary weapon of offence and defence, in their lower "lip." This remarkable organ is very long, and furnished with a pair of most formidable pincers or palps. The "lip" is attached by a kind of hinge to the chin of the insect, which is also fairly long, and the whole weapon, when not in use, rests against the under part of the body. When seeking its prey, the Dragon-fly larva remains quite motionless, or only moves very, very slowly and cautiously along, so as not to attract undue attention. Presently a small insect passes by at what looks like a safe distance,



THE DYTISCUS BEETLE

is a terror to the weaker inhabitants of the pond

but the unfortunate creature has not calculated that a telescopic weapon is carried by the foe, and in an instant the larva shoots out its pincer-armed lip, and grasps its unsuspecting victim. The Dragon-fly larvæ are most voracious creatures, and not only are they a terror to all the lesser fry of their aqueous world,



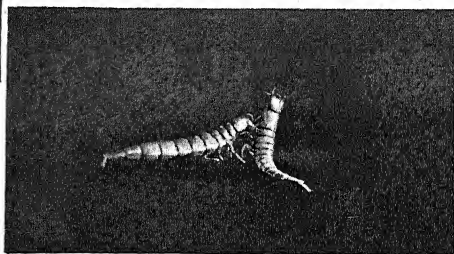
A DIFFERENCE OF OPINION LEADS TO—

but they are sorry cannibals. They can get out of the way of their own enemies with quite astonishing rapidity, considering the slow and deliberate manner in which they move about under ordinary conditions. When alarmed they expel the water in their intestine suddenly and with considerable force, which has the effect of projecting them at a rapid rate to a safe distance.

The Dragon-fly undergoes what is termed incomplete metamorphoses; that is to say, the larva does not change to a quiescent chrysalis as does the larva of a butterfly or a beetle, but gradually changes to what is called a "nymph," though anything more un-nymphlike in appearance it would be difficult to imagine. It was, indeed, a sorry and sardonic piece of humour on the part of the worthy man of science who gave these ungraceful, bloodthirsty creatures the beautiful old Greek name *nymph*, for they are singularly unlovely. They resemble the larvæ in general habit and appearance, save that the body is longer, and has upon the back the rudiments of wings. When it is ready to undergo its final transformation, the "nymph" crawls up the stem of a reed, and, resting in the sunshine, allows its body to dry. The skin then splits, and the perfect Dragon-fly emerges. For a while it rests upon the empty nymph-case, to permit its body-plates to

harden, and the gauzy wings to expand and dry, and then it flits away like a living flash of light.

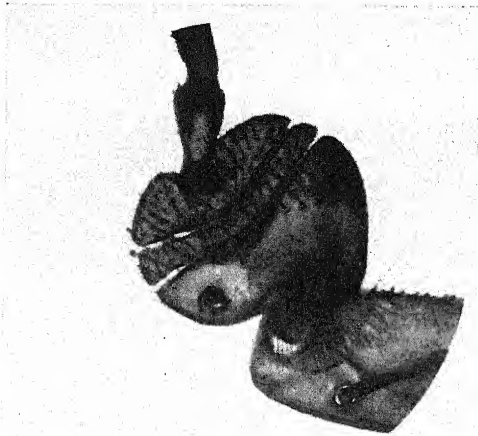
Another terror to the inhabitants of the pond is the Water Beetle (*Dytiscus marginalis*), which in both the larva and adult stages of its existence is carnivorous in its habits, and attacks all kinds of aquatic insects, small fish, newts, and tadpoles. The larvæ have cylindrical shaped, tapering bodies, with fairly long legs. Their head is large and broad, and their powerful jaws, or mandibles, are arched, and perforated at the tips,



A BATTLE ROYAL (DYTISCUS LARVÆ).

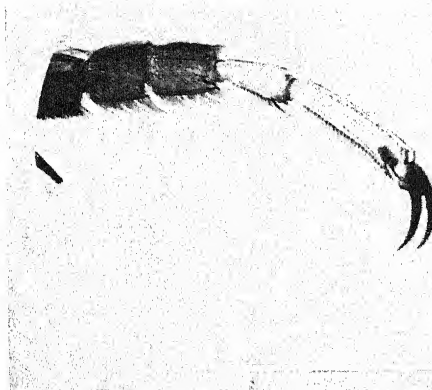
so that they can suck the blood of their victims. These *Dytiscus* larvæ, besides being armed with powerful jaws, have very thick and tough skins, so that they have comparatively little to fear from foes of their own size. They are very pugnacious creatures, and are given to fighting amongst themselves, and if kept in an aquarium deadly combats may be witnessed, the vanquished becoming a banquet for the victor. When ready to change to the pupa stage of its existence, the larva quits the water, and excavates for itself a little cave or chamber in the earth on the bank of the pond, and within this safe retreat casts its skin and becomes a dormant pupa.

In due course, the *Dytiscus* beetle emerges from the cave in which it has passed through its final transformation, and plunges beneath the surface of the pond. Clad from head to foot in hard, horny armour, and with the mouth parts developed into powerful biting organs, *Dytiscus* is more than a match for any inhabitant of the pond, save a full grown pike, or a duck, and accordingly he leads

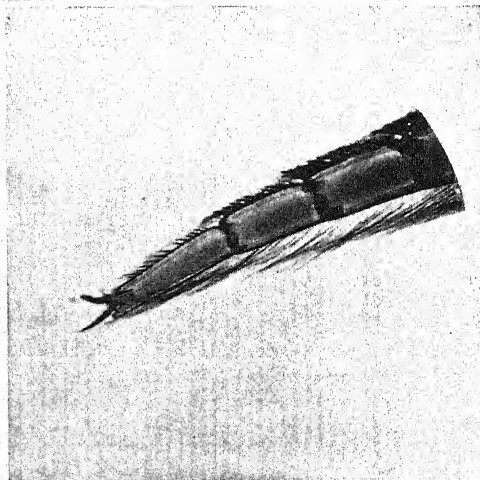


FRONT LEG OF MALE
DYTISCUS BEETLE.
Showing the curious suckers.

an arrogant and somewhat sanguinary existence. Even his courtship is carried out in a pugnacious manner, and the males fight fiercely for the possession of the females, whom they treat with but scant courtesy. The three pairs of legs of the male Dytiscus are very remarkable, each pair being adapted to a special purpose. The first pair bear, near what may be termed the wrist, a disc covered with curious suckers, which enable the beetle to obtain a close grasp of any object, and are also used to embrace firmly his coy and slippery lady-love. The second pair are long, and terminate in powerful hook-like claws, admirably adapted for climbing up the weeds and banks of the pond; while the third or hind pair of legs slightly taper towards the foot, and are fringed with stout hairs, making ideal paddles with which Dytiscus propels himself through the water.



THE SECOND LEG
(MIDDLE PAIR) OF
DYTISCUS.
Used for climbing.



HIND LEG OF DYTISCUS.
Used in swimming.

At frequent intervals these beetles rise to the surface of the pond, and thrust out the end of their body to take in a fresh supply of air, through the spiracles or breathing pores, which lie just under the wing cases along the sides of the body. During the summer, should food grow scarce, or the pond show signs of drying up, the Dytiscus will crawl up the reeds, or on to the bank, and spreading its large and powerful wings, fly off in search of more congenial quarters. This migration of the Dytiscus beetle from one pond to another has been attended by some very curious and interesting results, for

it has undoubtedly helped to spread the now almost universal growth of the Canadian pondweed in our ponds, lakes, and slow, shallow streams. The story of the introduction of this prolific weed into England is rather interesting. Some living specimens were sent over to the

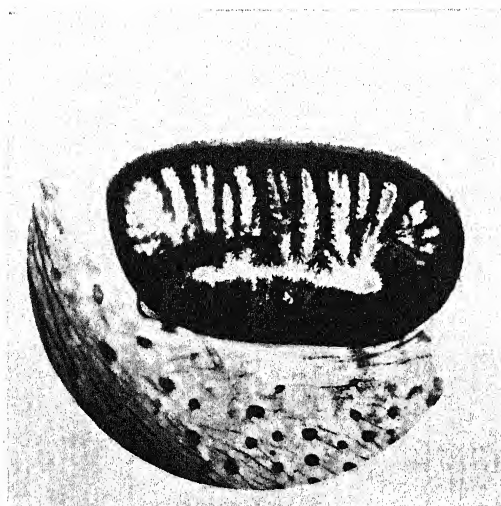
botanical laboratory of one of our universities some years ago, and ultimately escaped into the river. It is a plant that makes very rapid growth under suitable conditions, by throwing out young shoots and roots from the main stem, so that a small piece thrown into a pond soon establishes itself and becomes a dense tangled growth.

Moorhens, wild duck, and geese, as well as the Dytiscus beetles, get their legs entangled in the weeds, with the result that small pieces of the brittle stem are detached and carried away to the next pond or stream, as the case may be; and in this way the plant has spread to nearly every pond and stream in England.

Dytiscus has several interesting though smaller relations, denizens of the pond, who are more oval in shape, and, although of lesser size, equally rapacious.

A curious and interesting beetle is the Whirligig, which has gained its popular name from the quaint, rapid, gyrating movements it performs upon the surface of the pond. The position of the eyes at the side of the head of this beetle is so arranged that it may practically be said to have four, the lower pair looking down into the water, while the upper look upwards. The result is that while with the lower pair of eyes the Whirligig watches for its prey or for the approach of an aquatic foe, it can at the same time keep a sharp look-out with the upper pair for any feathered foe that might swoop down from above. The larvæ of the Whirligig are very quaint-looking creatures; they somewhat resemble small centipedes, owing to the body segments being furnished on each side with slender,

leg-like processes, some of which undoubtedly serve as breathing organs. When alarmed by the approach of danger from above, the Whirligig beetle ceases its circling movements, and instantly plunges beneath the surface, taking with it a large air-bubble wherewith to supply its needs during its temporary absence from the surface.



THE SPIRACLES THROUGH WHICH THE DYTISCUS TAKES IN ITS SUPPLY OF AIR.

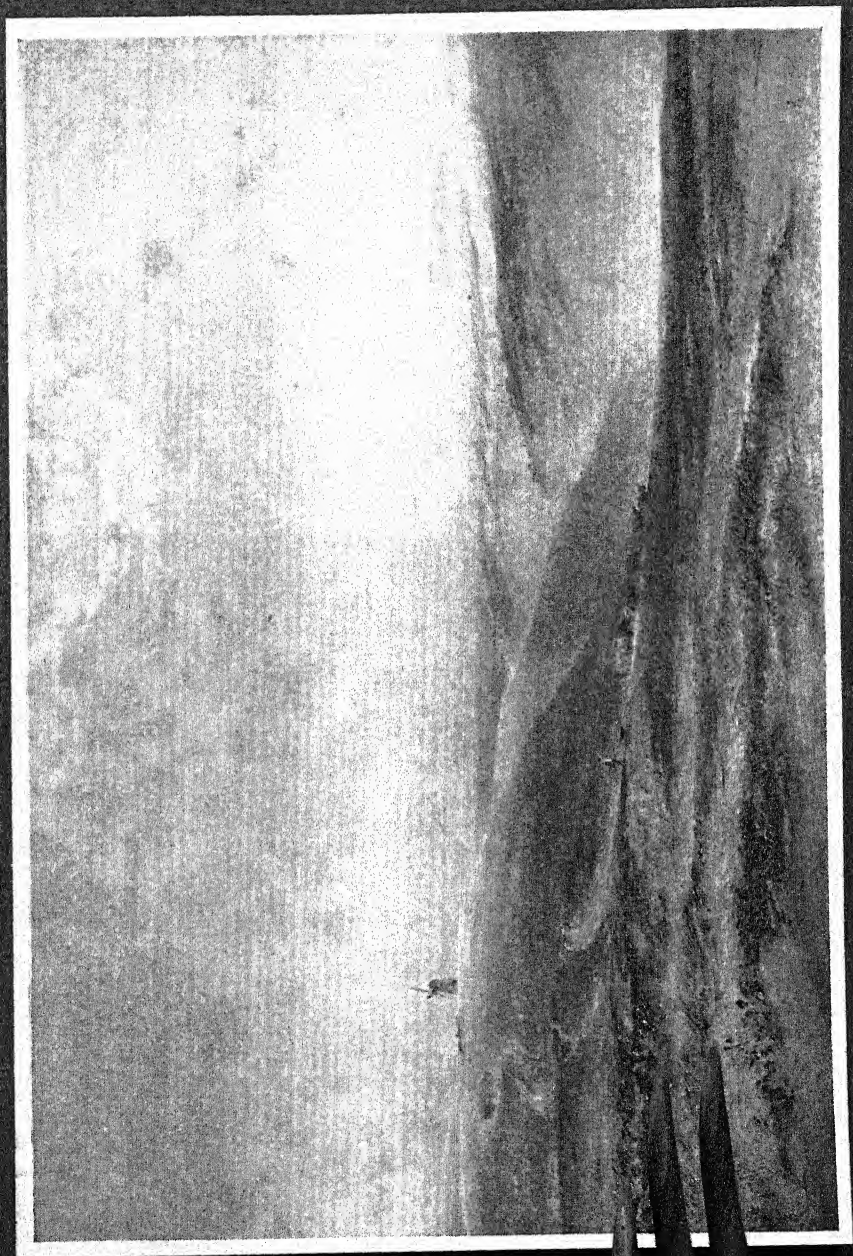
The Great Water Beetle (*Hydrophilus*) is one of the largest of our British beetles, and while it somewhat resembles Dytiscus in general appearance, differs from it completely in habits, for it is sluggish in its movements, and is a vegetarian. It is of uniformly deep black colour, and more convex in shape than Dytiscus. *Hydrophilus* also rises to the sur-

face to take in its air supply; it comes up head first, and by a peculiar movement of the antennæ causes the air to descend to the fine hairs that clothe the thorax or chest, and these in turn pass it on to the openings of the breathing tubes. Curiously enough, although a vegetarian in the adult stage of its existence, as a larva *Hydrophilus* is carnivorous.

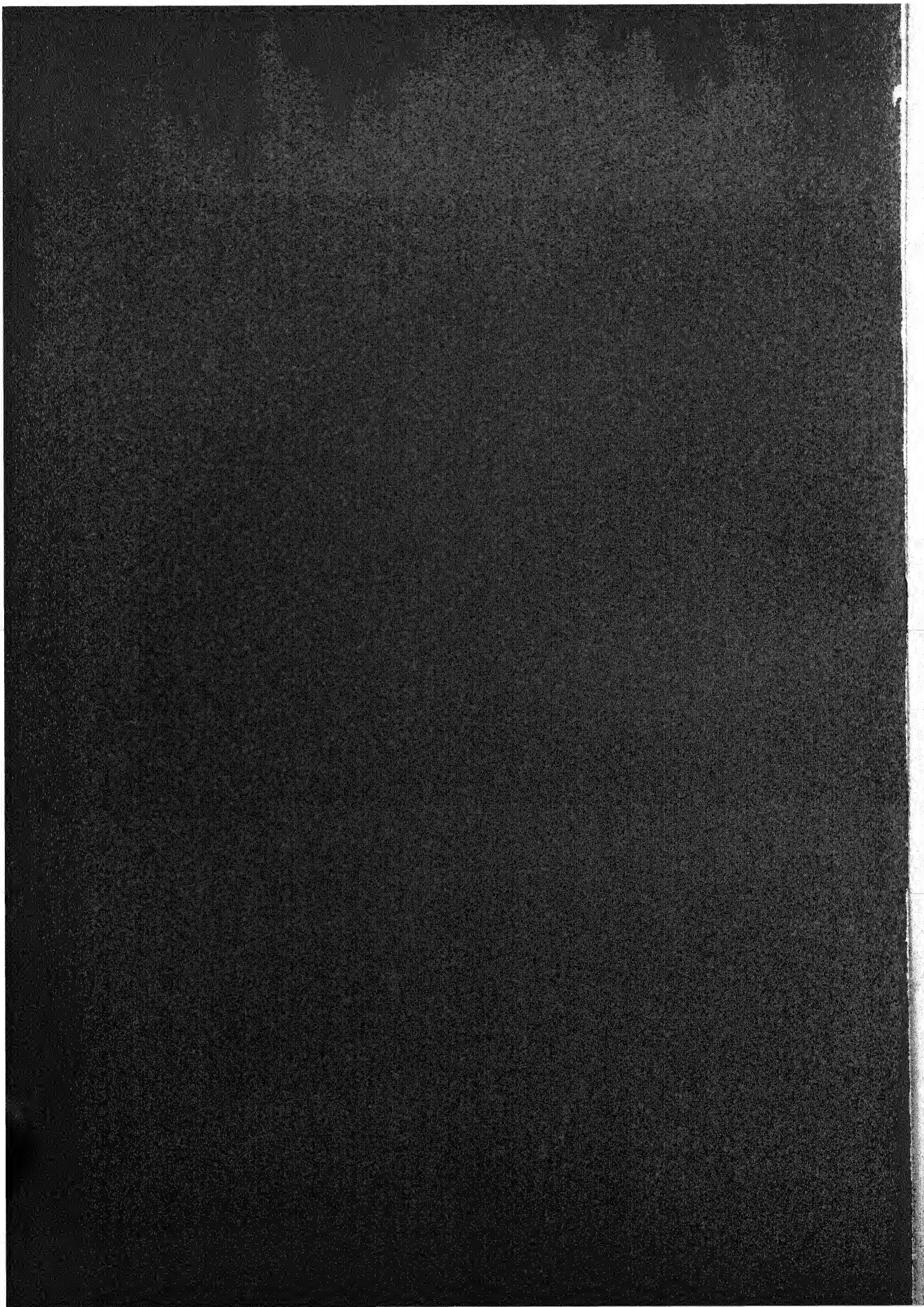
During the spring and early summer we may frequently see at the bottom of a clear shallow pool the untidy bundle of small twigs, or leaves, moving slowly and cautiously along, which indicates the presence of Caddis-worms.* It is a very interesting experiment, carefully and without injury, to rob a Caddis-worm of its tube, and to place it in a saucer of water containing some fragments of twigs, leaves, sand, etc. The insect will at once set to work to collect the pieces of twigs, and weave them together into a new protecting garment.

F. MARTIN DUNCAN.

* See page 571.



THE SOUTH DOWNS
From the West-Colour Drawing by Cecily Fildes in the Victoria and Albert Museum.



LAKES AND THEIR FORMATION

By J. LOMAS, F.G.S., A.R.C.S.

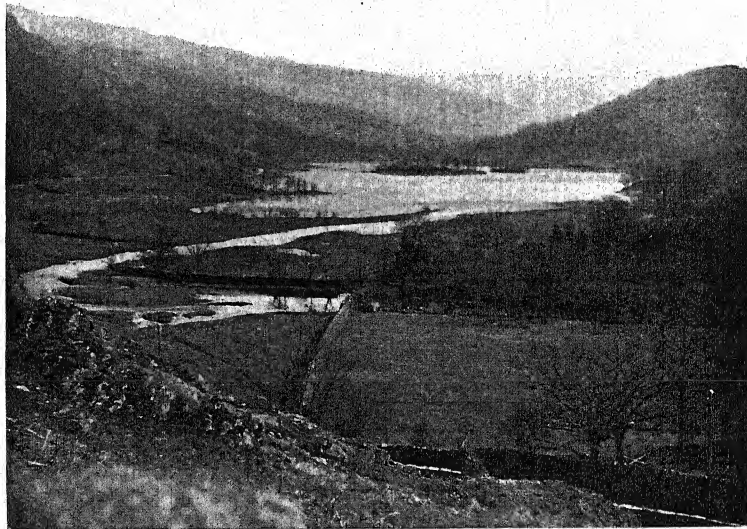
WE can sum up the characteristic feature of a river in one word—activity. Every drop of water coursing through its channel seems to have a set purpose in view, and hurries along as fast as it can consistent with the jostling against its fellows and the hindrances caused by obstacles in its path. But mounting and sinking, eddying and turning, it never rests. Its power to overcome difficulties and to accomplish its purpose is mainly kinetic.

Contrast this with the lake which interrupts for a time the progress of the river towards the sea. Here the dominant feature is tranquillity. The varying phases of the lake reside not so much in itself as in its environment. It borrows its moods from the glint of the sun and the passing cloud shadow. It mirrors steep crags and gentle pastures, and on its still surface "float double—swan and shadow."

The storm gust rushing down from the encircling heights may for a time ruffle the surface into waves, but in the depths all remains calm and silent. The energies possessed by a lake are potential rather

than kinetic, but where the waters leave to form the river anew the stored up energy again takes on the active form.

In passing through the resting stage the river changes many of its characteristics. It enters a fitful uncertain thing, now



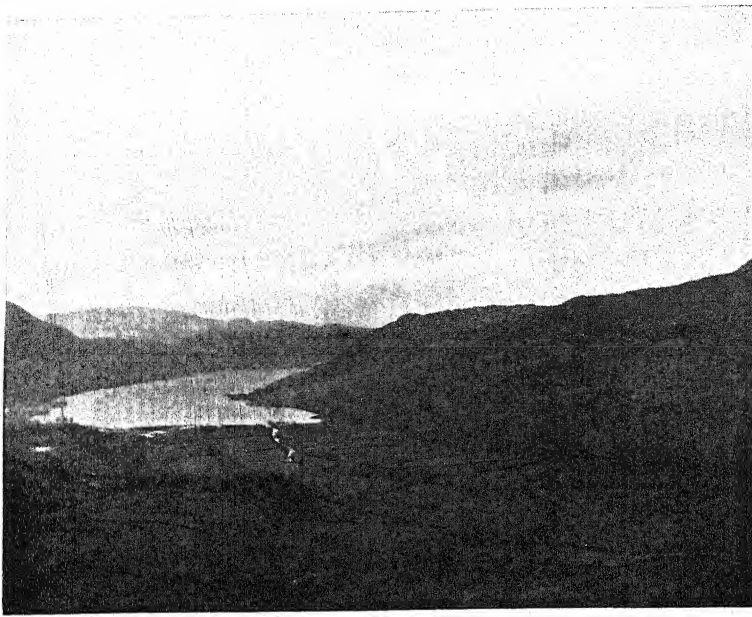
Photograph by Tomkinson, Liverpool.

"BANKS OF SAND AND MUD FORM A DELTA WHERE THE CURRENT ENTERS THE LAKE."

Rydal Water.

strong, when in flood, now feeble, in times of drought. It leaves a constant, steady stream, and may be relied upon to do its task in all weathers and at all times. It enters, mud-stained and carrying a burden gathered from the mother hills; it leaves, clear and limpid, clarified from earthy waste, free and unburdened.

But in setting free the river the lake contributes to its own undoing. The carrying power of the inflowing stream is



"THE SWAMPY FLAT INDICATES THE FORMER EXTENSION OF THE WATER."

Head of Haweswater.

lessened when its motion is arrested by the tranquil waters, and banks of sand and mud form a delta where the current enters the lake. The finer sediments discolour the water far into the lake, but they gradually sink to the bottom until finally only the minutest specks of ultra-microscopic dimensions are left suspended in the liquid. A tumbler of water taken from this zone would appear to our coarse senses clear and spotless, but the tiny particles become apparent when the more delicate effects of colour are produced by the filtering of the sun's rays through the medium. The wonderful shades of blue and green which delight the eye when gazing into the depths of lakes fed by turbid streams are the direct products of the interference of these particles on the sunlight which falls on their surfaces and penetrates into the depths. The constant deposition of material causes the delta to spread, and the tract of low marshy ground at the head of all lakes fed by muddy streams is a measure of the infilling which has taken place. Through this swampy flat which indicates the former extension of the water, a narrow channel is kept clear in the direct line of flow.

Tributary streams, too, entering at the sides deposit the *débris* they carry in suspension, and fan-shaped deltas grow out from the banks towards the middle. On the western shore of Tal-y-Llyn, near Cader Idris, one of these fans has crept far into the lake. In the Straits at Haweswater, only a narrow channel intervenes between the delta of the Measand Beck and the opposing shore. In

course of time the lake may be spanned from shore to shore; thus it becomes divided into upper and lower parts, whose waters are only connected by a sluggish stream which breaches the barrier on the side opposite to the entering tributary. With this in view it is not difficult to account for the fact that a great number of our lakes occur in pairs. Derwent Water and Bassenthwaite Water, once continuous, have been severed by the waste brought down by the Greta, Newland's Beck, and other minor streams. Grasmere and Rydal Water are spanned by the delta of the Dunney Beck; Buttermere and Crummock Water by Sail Beck and the neighbouring brooks. In North Wales we have Llyn Peris and Llyn Padarn, and in Ireland the two lakes in the Valley at Glendalough.

Water-loving plants soon get a foothold in shallows of the deltas, and the rate of deposition is rapidly increased as the muddy water is strained through the matted sieve of roots and stems. The growth of water plants is an important factor in the infilling, not only at the head but also on the shallow margins of the lake. The plants march in regular order

from the banks towards deeper water. The advance guard consists of such forms as *Myriophyllum* (the Water Milfoil), *Potamogetons* (Pondweeds), *Hippuris* (Mare's Tail), and *Chara*, whose parts are wholly or in large measure submerged beneath the surface of the water. Then come the plants with floating leaves such as *Nymphaea* (Water Lily), and the broad *Potamogeton*. Next we find the Reed zone, whose roots, and portions of their stems, are submerged, while the main portion of their vegetative parts is above the surface. They flourish where the depth of the water does not exceed four feet, and include such forms as *Phragmites* (the Common Reed), *Scirpus lacustris* (Bulrush), and *Typhas* (Reed Maces). Behind these, in still shallower water, is a dense growth of Iris, Juncus, *Gallium* (Bedstraw), Orchids, Water Forget-me-not, Spiraea and Meadow-sweet. On the verge of the dry land we meet with a grassy zone with *Carex* and *Scirpus*, the King Cup and Cuckoo flower, and the rearguard consists of Alders, Willows, and other trees, whose roots strike deep into the waterlogged soil. Floating plants such as Duckweed, Bladder-wort, and the Water Violet may extend into the interior beyond even the submerged zones. It does not follow that in all waters the same assemblage of plants will be found, but the same physiological zones are met with, the species occurring at any one place being dependent on local conditions. Year by year dead leaves and other vegetable products sink to the bottom, and gradually raising the floor, the marginal forms find their proper

habitat nearer and nearer the middle. Eventually the whole basin may be filled, and its former site is marked only by a peaty soil.

Thus we come to see that lakes are only evanescent features, and none can claim any great antiquity. Their presence in the landscape is a sure sign that the drainage system of which they form a part is young and immature. They are but incidents in the life of a river. Similar conclusions as to their age are reached when we consider the distribution of lakes of this class. In Great Britain they are only found in areas which were overridden by glaciers in the great Ice Age. The same associations hold good in North Germany, Scandinavia, Russia, and North America. We know that during the ice period the ordinary drainage of the countries affected was interrupted and modified. When the ice melted away many rivers found their old beds filled up, and they were forced to discharge their waters along new channels. We cannot count in years the time which has elapsed since the Ice Age, but we know that it is one of the most recent events in the Earth's history, and the rivers in developing new



Photograph by Tomkinson, Liverpool.

"ONE OF THESE FANS HAS CREEPT FAR INTO THE LAKE."

Tal-y-Llyn.

lines of drainage have not had sufficient time to mature their courses. They are now engaged in grading their channels, filling up hollows and removing obstacles, and, given time enough, they will again attain perfect adjustment.

We are now in a position to inquire how the drainage of a country may be disturbed in such a way as to produce

of mountain cirques or spread over a valley track, usually where the sides converge to form narrows. In its efforts to squeeze a broad mass through a contracted gap the ice became vertically thicker and moved with a velocity greatly in excess of that flowing through the broader parts of the valley. The resultant effect was to overdeepen the floor, and a hollow was

cut out of the solid rock. If the rim of the basin can be followed all round without a break, and the outflow is seen to be over solid rock, there can be no dispute as to the origin of the basin, but very frequently the ground is strewn with glacial *débris* which hides the true relationship.

Turning now to those lakes formed by earth movements, we must seek for them in places where



"ONLY A NARROW CHANNEL INTERVENES BETWEEN THE DELTA . . . AND THE OPPOSING SHORE."

Straits of Haweswater.

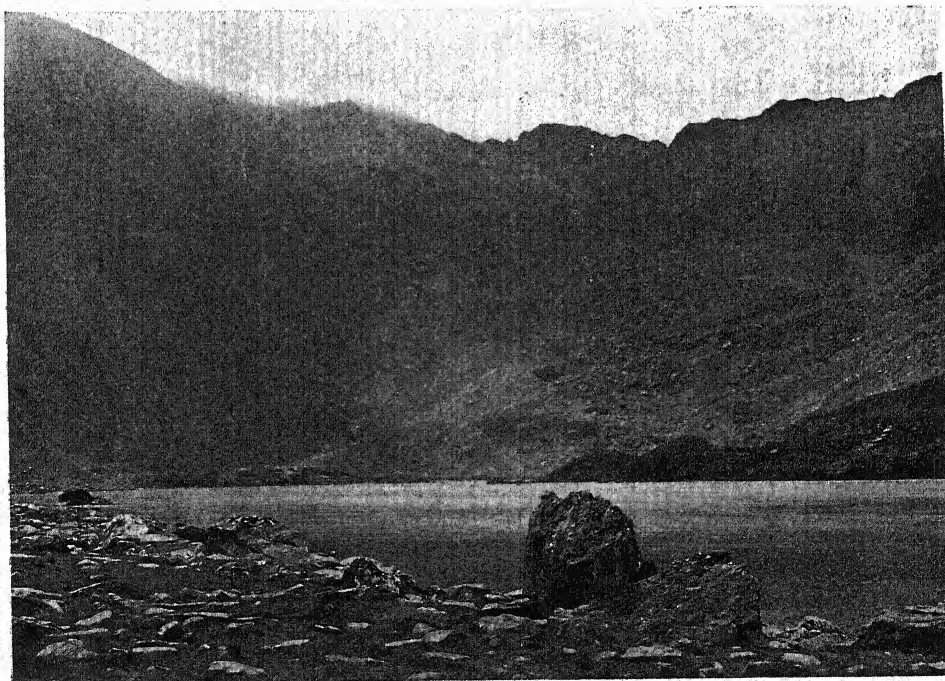
lakes. Their distribution would lead us to suppose that glaciers were responsible in some or perhaps the majority of cases. Earth movements, too, resulting in upheaval or depression across the line of a valley would obviously raise barriers which would hold up water to the level of the outflow, or cause depressions in which the waters would lodge.

A glacier may work in two ways. The ice plough may cut more deeply in one part of its course than another, or it may leave a moraine or other *débris* in a valley in such a way as to obstruct the course of the river. When the first of these causes has been at work we get lakes of erosion, and they may be compared with reservoirs excavated below the general level of a valley. They nestle under the steep cliffs

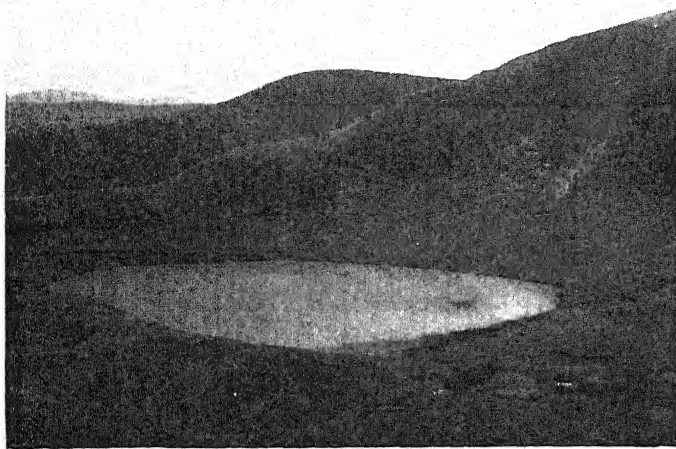
the crust has been subject to changes of level in recent times. The chain of lakes in the basin of the St. Lawrence river affords conclusive proof that changes of level have taken place since the Glacial Period, and the tilting may still be in progress. Earth movements may result in the production of faults or fractures, and when the land between two fractures has dropped, or, what comes to the same thing, when two areas are raised, leaving a part between unaffected, we have a trough or rift formed. If the floors are inland and below sea level, or at a lower level than the drainage system of the country, water must lodge in them and form lakes. One of the best known rift valleys runs in a north and south direction through Asia Minor far into the interior



Photograph by Steele, New Brighton.
"THE MUDDY WATER IS STRAINED THROUGH THE MATTED SIEVE OF ROOTS AND STEMS."
 Ullswater.



Photograph by G. Bingley, Headingley.
A LAKE OF EROSION.
 Llyn Idwal.



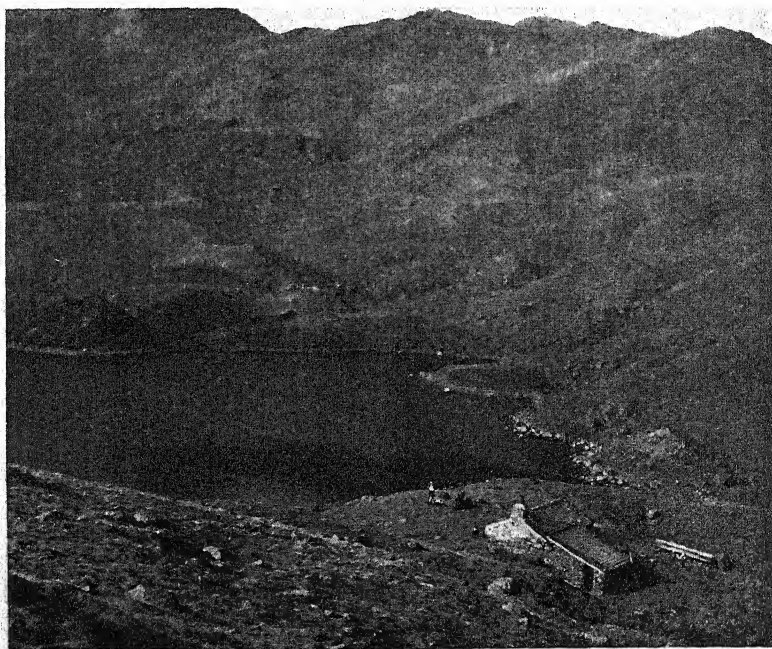
Photograph by G. Bingley, Headingley.
 "THEY NESTLE UNDER THE STEEP CLIFFS OF MOUNTAIN CIRQUES."
 Llyn Lllyn-Caws.

of Africa. It is of gigantic size, and is marked by a chain of lakes—the Dead Sea, Lake Rudolf, and others—some of which have floors beneath the level of the sea.

Another great valley of depression exists in the Western States of North America. In Oregon, Nevada, and in California, are vast areas 300 feet or more below sea level. They represent blocks which have fallen between mountains rising to 8,000 to 9,000 feet above the sea. Torrents flowing from the high grounds in the rainy season produce lakes in the depressions, and in arid regions the waters are evaporated during the dry season. Thus there remain only flat muddy deposits, bor-

dered near the hills with torrential gravels and sand. But the water flowing from the high grounds contains salts in solution, and as these are left behind when the water is evaporated, deposits of salt, gypsum, borax, and other substances are left behind. Soil impregnated with these substances is unfit for the support of life, and the places covered by this become deserts. Salt lakes are found in all desert areas. Although the climate of our country does not admit of the production of salt lakes at the present day, we have reason to believe that the salt deposits of Cheshire and other places represent accumulations formed in lakes when the rate of evaporation exceeded the water brought into them by streams.

J. LOMAS.



Photograph by Tomkinson, Liverpool.
 "THE GROUND IS STREWN WITH GLACIAL DÉBRIS."
 Easdale Tarn.

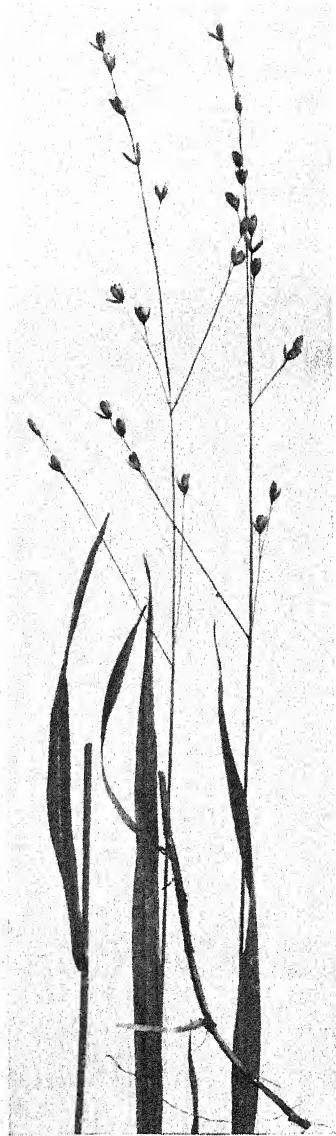
GRASSES OF THE WOODS

By MAUD U. CLARKE

With Photographs by HENRY IRVING

ADAPTATION to locality being the great law concerning Nature, we always find this response shaping the species according to the situation or habitat, so that there is an interweaving and solidifying of the compact. For the species is moulded by the habitat, and the habitat in time is characterised by the species.

The sheltered slopes of land that lie below the windy spaces of the hill-tops present two important factors for success in the life of vegetation, warmth and moisture. Here our woods became established in bulk, many varieties of trees forming dense belts of shelter for lesser shrubs and plants. The trees being responsive to the conditions of situation, formed a habitat that reacted upon the tribe dwelling beneath them, and of that tribe the Wood Grasses form a distinct family. Perhaps not many ever consider the Wood Grasses at all. The trees stand first as notable objects for admiration; and the flowering under-shrubs and plants attract attention



WOOD MELIC.

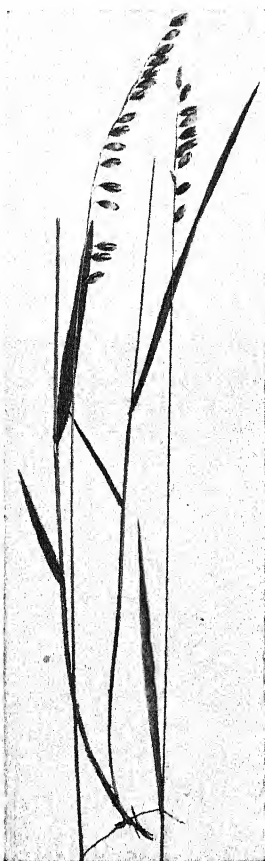
generally. Yet one can scarcely turn in memory to the woods without recalling those broad areas of green blades that pierce the dry leaves in spring, or the handsome isolated tussocks of grass that thrive in the moist shelter of trees.

There is something about a colony of the Wood Melic (*Melica uniflora*) that at once attracts the attention as being grass, and yet in a subtle way differing from that of the open spaces. Impressions are sometimes exceedingly difficult of exact explanation; yet one fact concerning this grass may offer something towards an explanation, since it holds the leaf-sheath closed after the manner of the Sedges, although in other respects it is classed separately from them.

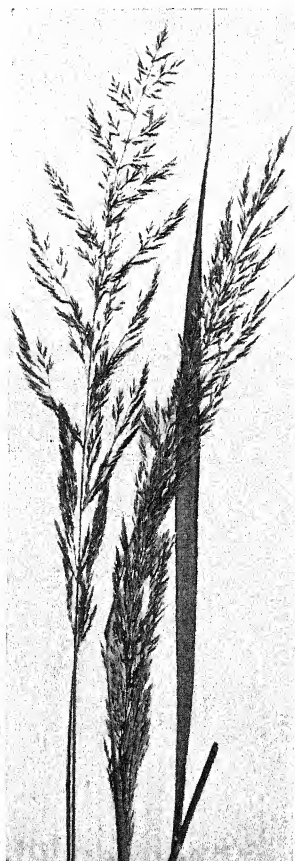
In May and June, when the wild hyacinths are colouring the woods with their purple-blue, the Wood Melic raises its slender flower stems of few spikelets. The stems are exceedingly fine, trembling in any draught of air that filters through the undergrowth, the whole

construction being fragile in character. It is a one-flowered grass, the fruit-bearing scheme being comparatively attenuated as compared with other grasses. The plant with the creeping rootstock is always the one to make colonies for itself and force aside other species. In this way the Melic may spread itself at the foot

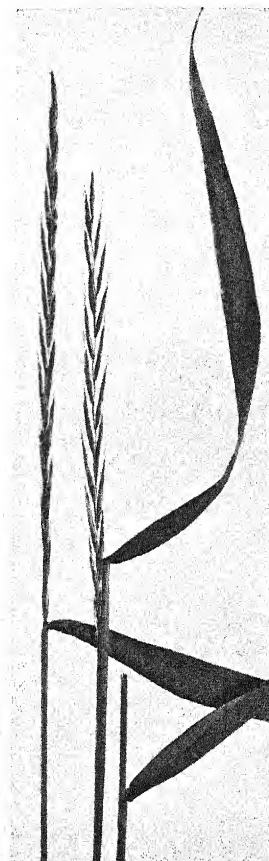
Melic is reduced to an almost spike-like raceme hanging the brown or purple flowering glumes all on one side. It is also a simply constructed two-flowered grass, producing those flowers early in the year during May and June, and in habit a perennial; both varieties average from one to two feet in height.



MOUNTAIN MELIC.



WOOD SMALL REED.



BEARDED COUCH.

of a group of beeches where the smooth trunks rise from the dark leaf-soil in comparative bareness. Here the carpeting of green blades will hold its own, even choking out the Dog's Mercury, another colonising plant that splashes the dry leaves with its strong, dark green foliage.

Melica nutans, or Mountain Melic, although a shade-loving species, grows in more rocky regions where, maybe, stunted bushes give shelter. In this species the slender spreading panicle of the Wood

One of the commonly known grasses of our damp woods is the Millet Grass (*Milium effusum*). It is the only British species of that family, and a very handsome one, raising, as it does, erect, strong stems of four feet, with fine branching panicles of small glumes that catch the glint of the light as it drops down through the trees on their smooth surface.

Usually the ground surrounding the tussocks is mossy with perhaps the brilliant green of the Fern Moss or grey

flecking of the Trumpet variety, and a flush of Scarlet Elve Cups on the rotting twigs.

The blades of the Millet Grass are broad, flat, and thin, curving in graceful profusion below the flowering stems. In the gaps between the young hazel and ash, where due shelter is given all round it, the grass lives in favoured conditions; giving shelter in its turn to the White Woodruff, Yellow Pimpernel and Purple Ground Ivy.

Another of our fine grasses is the Wood Small Reed (*Calamagrostis epigeios*). The term "Small Reed" seems a little inappropriate when designating a species that attains five feet in height. It is a stout, erect grass with a crowded panicle of many purple spikelets shortly awned, sometimes measuring as much as a foot long. It likes the more open spaces in our woods where it is free to air and light, yet has the sheltering ring of growth round it. We cannot, however, claim that it is a commonly found species, for it is more local in habit than others. When not interfered with it makes strong root-hold, flowering through June to August.

Agropyrum caninum, or Bearded Couch, is perhaps more often found on the outskirts of the woods, just within the ring of shelter or bordering the wood tracks. This is a fibrous-rooted species with three-foot stems and bright green spikelets possessing two to five flowers, the flowering glumes having long awns. The strong, broad blades, projected from the leaf-sheaths, resemble those of wheat, and the name *Agropyrum* is derived from two Greek terms meaning respectively a field, and wheat. The plant is a perennial and flowers through June and July.

All these strong-growing perennial grasses make covert for a most varied assortment of insects and their larvæ, and I have watched hedgehogs on the warpath most industriously quartering every foot of the miniature jungle.

In contrast to the solid growing varieties is that fine trailing species that almost suggests spray in its panicles, the Wood Poa, or Meadow Grass (*Poa nemoralis*). Rather a feeble grass, it props upon the surrounding growth, or soon trails on the bare ground. Although attaining three feet of height, it is a slender scale of growth, the leaves being very narrow, and the loose panicle composed of very small spikelets. They are green or purplish in colour, and generally three-flowered, extended upon branchlets that have a waved line of formation.

The plant is slightly inclined to creep, is perennial, and quite a commonly found species in our woods and copses. In autumn the dry glumes have rather a greyish tint than tawny, which suggests spray or mist drifting above the green undergrowth. The form of the panicle may remain per-

fectly expanded, but the glumes, empty of the seed, contract closely together.

Quite distinct in type, the Slender False Brome (*Brachypodium sylvaticum*) sends up its erect, solitary flowering stems of one foot or even three feet in height amongst masses of hairy blades. The number of spikelets is usually seven or eight, carried on a slender curving stem that is indented for their reception, since they stand loosely away from it. We are quite familiar with the broad, often yellowish green blades springing among the shrub-growth, or on the outskirts of the woods, although



WOOD POA, OR MEADOW GRASS.

it is equally a hedge grass, and, indeed, met in the odd corners also. For grasses have a fashion of their own in often evading restrictions and turning up in out of the way places. The varieties of the Brome family are many, and this one is recognised as having broad, long hairy leaves with something of the tufting character as shown in the right-hand specimen of the illustration. There are often late flowering stems found in the autumn, when the blades have acquired that dull brownish-green colour that means stagnation in the sap, and heralds the fading into the bleached whiteness of the winter months.

I think, perhaps, by those who are genuine wood-prowlers, who never cease to find woods of interest even in the winter, and from sheer force of habit turn up the familiar tracks day by day, the grasses can be studied to purpose in their dry dead state.

When all the wood plants have seeded, and a cool moist silence pervades the shelter of the trees, then the dry grass-stems stand up and take their part in the uniform order of things. Faint straw-colours, or bleached greys, take the place of vivid greens among the wet leaves, but the individual forms are all still distinct, although in shrunken condition. One cannot mistake a stem of the Cocksfoot Grass that springs beside the grass track for any other, nor does the autumn

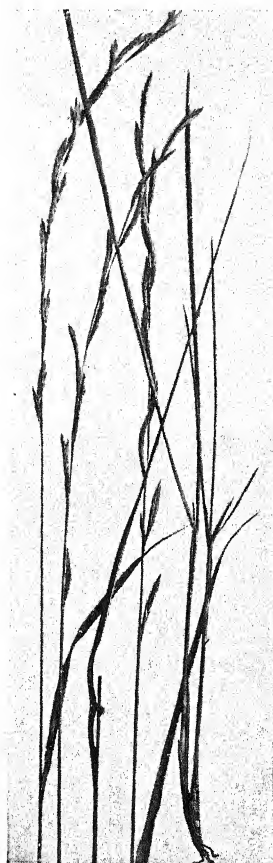
bearing disguise the Millet Grass, still stiffly erect above the almost evergreen mass of blades. In the dry areas of the wood where the dead seeded capsules of the Campion tangle are all that show of

its summer beauty, there is the Slender False Brome fringing the rabbit-holes. Here and there a patch of the Soft Grass shows still bloomy in young shoots that have ventured up among the curled dry ones. The Tufted Hair Grass, too, in the wet hollows shows a series of dry lance-like stems, or the broken angles of those subjected to accident. It is grass everywhere, save where the dripping bracken and bramble vines hold the ground too densely.

This accumulation of the dead grasses above the earth, and strong massing of the fibrous rootstocks below, acts most beneficially for the protection of numberless seedling plants through the low temperature of winter nights. The superficial mass of dry stuff keeps the moisture from evaporating, and considerably modifies the bite of cold. The exquisite green leaves of the Wood Oxalis keep their brilliancy often through winter down among the mosses at the

foot of dead grass; and many an earth bank facing to the cold winds on the outskirts of the wood has its plant world comforted by the protection of the grasses. Dead or alive, they are of value in the grand economy of purpose that Nature displays when left to its own ruling.

MAUD U. CLARKE.



SLENDER FALSE BROME.



HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE BROWN HARE THE RABBIT

With Photographs by the Author

"Pulling her hand out of mine she ran back to where the dead Hare was lying, and flung herself down at its side in such an agony of grief as I could hardly have believed possible in so young a child. 'Oh, my darling, my darling!' she moaned, over and over again. 'And God meant your life to be so beautiful.'"

The Rev. C. L. DODGSON (Lewis Carroll) in "Sylvie and Bruno."

"No doubt Englishmen are the sportsmen of the world, but our Continental neighbours entertain a friendly rivalry with the Saxon, and the number of Hares which are annually killed at big drives in Austria represent enormous figures, beside which statistics of our English sport are dwarfed into sorry insignificance."

The Rev. H. A. MACPHERSON in "The Hare." (*Fur, Feather and Fin Series*).

HARES, Rabbits, Pikas and the *Romerolagus*, a quaint little Mexican beast which has been recently discovered, belong to a sub-order of rodents whose members, owing to their possession of four upper incisors in place of the more usual two, are called *Duplicidentata*. All known *Duplicidentata* are terrestrial, and all possess insignificant tails—indeed, *Romerolagus* and the *Pikas* have no external tails at all.

In Hares and Rabbits each front upper incisor is deeply scored down the centre, and therefore presents at its fined extremity two separate and narrow cutting edges. Behind each front incisor lies a smaller tooth, which no doubt strengthens the stability of the tooth before it, and also limits the depth of its penetration. We may assume from this structure that the shavings, which are the joint work of upper and under

incisors, are extremely fine, and this fineness of cut is sufficient to account for the ease and speed with which the animals bark young trees. It is possible that the rodents are descended from the extinct *Tillodonts*, whose most recent representative, the bearish *Tillotherium*, possessed, like Hares and Rabbits, an additional pair of small upper incisors. This suggests that Hares and Rabbits are a primitive type.

It is probably familiar to most of my readers that the differences in structure, habit, and character between the two species date from their earliest infancy. The young Rabbit is born in a burrow, blind, naked and small. The young Hare is born round-eyed, furry and sizeable, in the open.

Taking the Hare-Rabbit family as a group, it is of little moment whether we assume that Hares have abandoned burrows, or that Rabbits have abandoned the open, or that the



YOUNG RABBIT.

two types are divergent offshoots from less highly specialised ancestors. It should be noted, however, that many instances have been recorded of Rabbits constructing their breeding nests above ground, and of Hares depositing their leverets under substantial cover.

Though the fact that Hares breed almost throughout the year has long been known, the number of leverets in a normal litter was, until quite recently, a disputed question. It is now generally agreed that this number is usually five, and that the doe disposes of her progeny in two or three separate breeding "forms," which she visits regularly, and from which, if she suspects danger, she transfers them. It is not usual to find more than three leverets in one "form," but I have seen an excellent photograph of Mr. Farren's showing five, and I think it likely that five leverets which are born together will be left together for a day or two. In cold weather this disposition would certainly be advantageous.

Of all wild babies the leveret is the most lovable. I have never chanced on one which I have not felt tempted to appropriate (sometimes, I must confess, I have succumbed to the temptation), and I have never seen a photograph, or drawing, which suggested a leveret's innocence. A leveret's coat is curiously touzled (as though the owner needed a good brushing), but in this "touzling" we see something of Nature's method, for the light and shade of it, combined with a pepper-and-salt coloration, give exactly that "speckliness" which is of all colour combinations the least conspicuous.

Sometimes a leveret can be taken up quietly, but more often, if he is of any bulk at all, he will put up a laughable fight with his fore feet, and, if you still insist, will utter reiterated screams,

like those of an old-fashioned squeaking toy. It is of little use attempting to rear a leveret who is only a few days old, unless one can provide him at once with a foster-mother—the domestic cat has often been pressed into service. Should, however, one chance upon a leveret a fortnight or three weeks old, who is stocky in build, and capable of nibbling soft "tops," little difficulty will be experienced in rearing him if one can school oneself to respect

his instinct for dozing away the day-time under cover.

In rearing young wild animals over-attention is just as fatal as neglect.

To return, however, to the leveret at home. In order to see him clearly, the grass, or whatever shelters the "form," must be parted, and, even when this is done, one need only turn one's head to lose him. His ears, compared with those of the grown hare, are distinctly short,

but his eyes are almost as large and lustrous as his mother's, and the greater relative extent of the light fur-patch between eye and nostril, combined with the relatively blacker muzzle, so break up and confuse the outline of his head, that it needs a trained eye to see him two yards off.

He is, in fact, admirably specialised for avoiding observation. He needs to be; for it must be remembered that, from the moment of his birth, he has no more than a flimsy grass-screen to protect him, and in this respect, so far as British animals are concerned, is uniquely defenceless. Much of his protective coloration he carries with him to maturity. An adult Hare's ears are between four and five inches long, and present on their hind (or under) surface, a remarkable colour-scheme. Starting from the root-ends one finds first about one and a half inches of thick brown fur, then about two and a half inches of sparse blue-grey



BROWN HARE.

fur, and finally at the extremities well-marked triangles of silky black. A wild Rabbit's ears are also black-tipped, but the body colour of them is brown, and



WILD RABBIT.

this merges gradually into the black. When a Hare is at rest in his "form," his ears are laid back flat. In this position the patterns of the hinder parts of them are completely concealed, and the same thing happens when the Hare is extended to a gallop. When, however, he is lolling at his ease, or frolicking, or sitting up to listen, his ears are erect and expanded, and the markings, as seen from behind, are extremely conspicuous.

Mr. Kay Robinson has suggested that when a Hare's ears are projected above surrounding herbage, the black tips may have a protective value, inasmuch as the Hare's enemy would be naturally on the look-out for something *brown*. He quotes in support of this an interesting experience of his own. "My first idea," he writes, "was that they (the black-tipped ears) were some large black-and-brown butterfly with spread wings on one of the turnip leaves." (*Country Side*, May 12th, 1908.)

Mr. Kay Robinson's suggestion, ingenious though it be, is, in my judgment, untenable. In the whole scheme of

nature-colouring there is nothing so arresting as black. An isolated black object above shadow level screams for notice, and Mr. Kay Robinson's attention was attracted, as that of any other good naturalist would be, by the blackness of the Hare's ears. Anything which attracts the attention of man, let alone that of raptorial birds, would be poor protection for a Hare.

The white under surface (or scut) of a Hare or Rabbit's tail presents another puzzle. It is chiefly conspicuous when Hare or Rabbit is in full flight. With Mr. Kay Robinson's objection to the book-theory that these white "scuts" are guiding signals which enable young Rabbits to follow their parents to the burrow, "in the same way as the soldiers of Henry of Navarre were able to follow their leader's white plume through the thick of battle," I entirely agree. The facts are all against this naive suggestion. Startled bunnies do not follow each other's tails. It is a case of each one for himself. Some prefer to make for shelter, some lie crouched in the open. They are not remarkably intelligent animals, but they



WILD RABBIT.

have sufficient intelligence to avoid a procession in line ahead.

Both Hare and Rabbit being normally twilight feeders, it is conceivable that

the white scuts may serve a purpose in keeping the does and young together, but we must not forget that the white is most conspicuous in the bucks and that the diameter of the eyes in Hares and Rabbits indicates a very sensitive vision. The iris of a Hare's eye is golden brown, and the diameter of the pupil is slightly less than that of the pupil of a Rabbit's eye under similar conditions of lighting.



LEVERET ABOUT THREE WEEKS OLD.

In consequence of this the Hare's eye presents a bolder, more hawk-like aspect than that of the Rabbit, whose iris is often of a chocolate colour. The contracting power of a Hare's pupil appears to be somewhat limited, but the position and size of the eye, as a whole, imply an extended range of vision, and the fact that when pursued a Hare is concerned with what is behind him even more than with what is in front (hence the exquisitely timed "double") has led to some curious accidents. I have known a case of Puss completely flooring a man who had stooped to a half-sitting position, with his arms extended, to head her from a gap. Daniel gives an instance of a Hare colliding with a terrier end on. In this case the terrier was stunned and the Hare's skull smashed. I am not aware that the speed of a galloping Hare has been properly determined, but putting it fifteen per cent. less than that of a first-class greyhound, one may assume that it is not far short of thirty miles an hour. A ten-pound Hare travelling at this pace would be quite an effective projectile.

The ordinary length of a Hare's pace is about a yard, but when pressed Puss is capable of a great effort. Major Barrett Hamilton has recorded a leap of ten feet accomplished by a Hare running from a dachshund, and the normal standing leap from the "form" is often more than two yards.

As can be most easily determined by snow-prints, when the snow is of suitable consistency, the running Hare's hind feet strike the ground in front of the fore feet. The same "bucking" progress characterises the Rabbit, but in his case the hind feet come down side by side, whereas in the case of the Hare one is always a little in advance of its fellow.

Though I have seen five Hares simultaneously engaged in my one cabbage patch, the Hare is by nature a "solitary." His "form," in which he dozes through the day, is usually on high, dry ground, and fastidiously selected with a view to making the best of the prevailing weather. He seldom quits it before nightfall, though after a prolonged spell of bad weather hunger may occasionally impel him to feed by daylight. Normally he spends the day in digesting his last night's bellyful. Mr. Drane, who has contributed greatly to our knowledge of the Hare, has described an extraordinary habit which he has found to accompany a Hare's normal digestion. I must content myself here with informing the reader that the Hare does not "chew the cud" in the ordinary sense of the term, and must refer him for further details to Mr. Drane's papers in the transactions of the Cardiff Natural History Society, 1894-5.

Hares have frequently been kept in confinement, and every one who has kept them, and gained their confidence, is agreed as to the fascination of their ways, and the affection which they display towards their keepers.

Of the many wild creatures who have passed through my hands, and who, I think I may fairly claim, have honoured me with some show of confidence, the Harvest Mouse, the Badger and the Hare have appealed most to my sympathies.

I can add but little to the observations made by others on captive Hares. A question which has puzzled several observers is whether Hares ever close



STUDIES OF THE BROWN HARE.

their eyes in sleep. Mr. Drane has no doubt on this point; he declares, without qualification, that a Hare *does* close his eyes in sleep. That I have never seen a Hare close his eyes and retain them closed voluntarily for any length of time, is probably due to the fact that I have never gained a Hare's confidence so completely as Mr. Drane. That a Hare can close his eyes is indisputable. He will sometimes do so temporarily while you stroke him.

Millais quotes with approval Zola's description of a Hare's eyes as presenting "a bleak and frigid stare which does not seem to see," or, "an ever-haunting absent look as of one whom her sufferings overwhelmed." With these flowers of rhetoric no one who has kept a Hare can agree for a moment. A Hare's eyes are singularly expressive, and, of all the qualities which can be predicated of them, width and intelligence of vision are the most obvious.

One of the many engaging attributes of a Hare is his method of displaying resentment. Chuck a Hare under the chin, and he will rear on his hind legs, grunt angrily, and drum with his fore feet on your hand. This drumming (quick alternate strokes of the fore paws) is the Hare's main method of defence. His attack is a double-barrelled flying kick like that of the Rabbit. The drumming habit has been so taken advantage of, that instances are recorded of Hares having been trained to play tambourines. The performance seldom lasts long under ordinary conditions, for, realising its inefficiency, Puss soon relapses into sulks, with a look which shows as plainly as speech that your attentions are a little childish. He is far too much of a gentleman to bite, though he may nibble at your hand; biting is left to the Rabbit, whom Mr. Drane rather unkindly characterises as a "little cad." Mr.

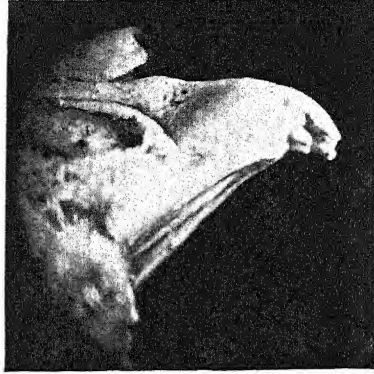
Drane's conception is probably based on the unsportsmanlike instinct which impels the fighting Rabbit to "bite below the belt." The Hare shows a strong aversion to the Rabbit, perhaps for this reason.

A few other peculiarities of the Hare may be noticed. On rising from his "form" he often throws back his head, arches his hindquarters, and stretches from the fore feet backwards—wild Rabbits often make a similar back-stretch. Sometimes he stands up on end and shakes himself while standing, a movement which is always accompanied by a quick shuffle of the fore feet. He has several curious basking

positions. A favourite one is the fullest possible extension of himself, with his hind legs pointing backwards, and his fore legs pointing forwards. In another, both hind and fore legs are pointing forward, and the great length of his hind legs brings all four of his feet in line, with his head thrown back behind them. Like a Rabbit, he is incapable of lying on his back, or in any curled position, and I have never seen him lie with both hind legs on the same side of him and his body skewed round—a position which Bunny Rabbit is rather fond of.

There is some question as to the voice of the Hare. Only two sounds have come within my experience. If annoyed he makes a snuffling grunt of disapproval, and if in an agony of fear, he utters a loud scream, which, like the leveret's, has the same quality as the squeak of a pneumatic toy.

"Hare-pipes" are frequently mentioned by the old writers, and also in the Statutes relating to game. In the latter they are, I think, without exception, placed in the same category as nets and gins, and it is, to say the least of it, doubtful whether the expression was ever used by an authoritative writer in any other sense. It is right to point out, however, that several



FORE PORTION OF A LEVERET'S
UPPER JAW.

Showing the small incisors' situation behind the larger ones; a peculiarity of dentition which is characteristic of the Hares and Rabbits.

good observers hold that both Hares and Rabbits have call-notes, and it is conceivable that "Hare-pipe" may on occasion have denoted a musical instrument used for producing a Hare call artificially. Calling out a Hare is not quite the same thing as calling out a Rabbit. In the case of gregarious animals it is well known that the squeal of one member of the community in distress will often bring up others. In his delightful book, "Wild Traits in Tame Animals," Mr. Louis Robinson suggests that the outcry of the doomed pig is a last despairing summons to his kind. It may be so from poor piggy's point of view, but I doubt if the motives which inspire his companions are purely altruistic, and I think that when a young Rabbit voices his misfortune, the instinctive desire of other Rabbits in the vicinity would be to suppress, as quickly as possible, a noisy and indecorous advertisement of the warren.

More, perhaps, is known of the daily round of the Rabbit than is known of the daily round of the Hare, but of the whole cycle of a Rabbit's life from year's end to year's end we have no certain knowledge. So far as his relations to the outer world are concerned, his chief concern appears to be that he shall have ample and dry space for breeding purposes. An ideal site for a warren is a sandy slope of heath-land, edging a pine-wood, with a south or south-west aspect. If, in addition to the ordinary heath-land vegetation (implying cover), there is cultivated land a short distance below, so much the better for Bunny. Although when the weather is favourable he, as often as not, lies out in a "form," the greater part of his existence is spent in the recesses of the burrows. We can only conjecture as to the conditions of this life, but it is probably safe to assume that in winter a number of Rabbits cuddle together for warmth, and that in hard weather they can pass a succession of days in a semi-torpid condition. The extraordinary fecundity of the doe Rabbit—she litters four or five times in the year, and there may be as many as eight or nine in a litter—necessarily has a direct effect on the economy of the warren. At the approach of the breeding season, say in late

February, it would seem, from the shoots of sand at the entrances of the holes, that a number of Rabbits who had wintered together had broken company, and that a general spring cleaning was in progress.

The first warm settled evening will bring Bunny out of his burrow. First comes the buck (to be recognised by his heavier head), who after much preliminary sniffing, a hurried toilet, and an im-



HARE IN ITS "FORM."

patient scratch at the ground in front of him, bounds off to his feeding ground, ears up and scut in rest. The doe follows, but, her responsibility being greater, she seldom ventures far. "Little and often" is her motto, and for this reason, I fancy, she not infrequently sallies out a short distance at midday. During the small hours she scratches out a burrow for the reception of her young, and lines it with her own fur. These breeding-holes turn up in unexpected situations, often at some distance from the main warren. In any but the coldest months young Rabbits are in evidence. Litter succeeds litter, and the neighbourhood of

a warren on a warm summer's evening presents a pretty picture. The bucks, all bounce and swagger, leaping across each other's backs, kicking, scratching, stamping; the does stretched out contentedly, or nibbling for the sake of doing something; the babies, of all sizes, and in all conceivable positions, sitting up like mother, scratching themselves like mother, "fondling their foolish faces," scuttling before imaginary danger, crouching before imaginary shadows. Sometimes the

danger is real—the cry of a hawk, the rustle of an adder or a stoat, the step of man. "*Thud, thud, thud!*" from one end of the warren to the other. The old Rabbits are stamping with annoyance. Up go the tails, the white scuts bob and flutter, and in a moment the warren is empty. Walk slowly forward. Rabbit after Rabbit will start up from beneath your feet. Stoop down and listen. You will still hear them stamping.

DOUGLAS ENGLISH.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

THE APPLE AND PEAR GROUP*—I

THIS group, as already stated, is closely allied to that of the Plum and Cherry, being of the order of the Rose. In the trees of this group the fruit is formed beneath the calyx, which as a dried rosette or crown remains attached till the fruit is ripe.

THE CRAB OR WILD APPLE

The usual habit of this tree is to divide into branches rather low down. These spread out-

*Includes the Apple, the Pear, the White Beam, the Wild Service, the Rowan, and the Hawthorn.



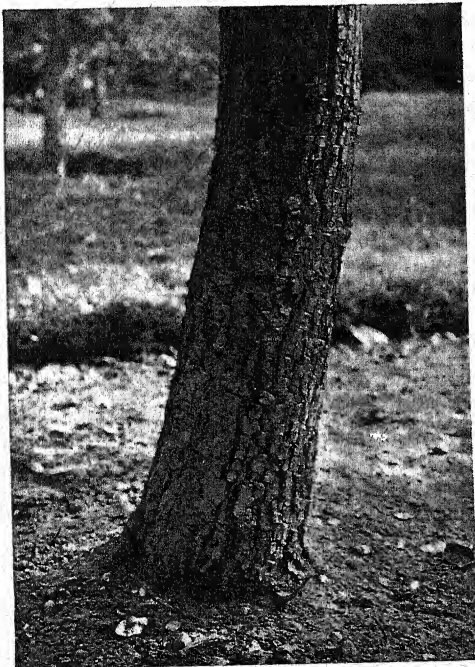
BARK AND TRUNK OF APPLE TREE.

wards and upwards somewhat irregularly, so that the crown is low and rounded. There is often considerable density in the lesser branching, suggestive of a thicket of shoots and twigs. The sight of the Apple tree in full bloom, whether wild or under culture, fills one with a kind of amazement. The mass, the fulness, the warmth of colouring, its suggestive sweetness, set this tree apart from all others. It seems to crown the floral beauty of the season.

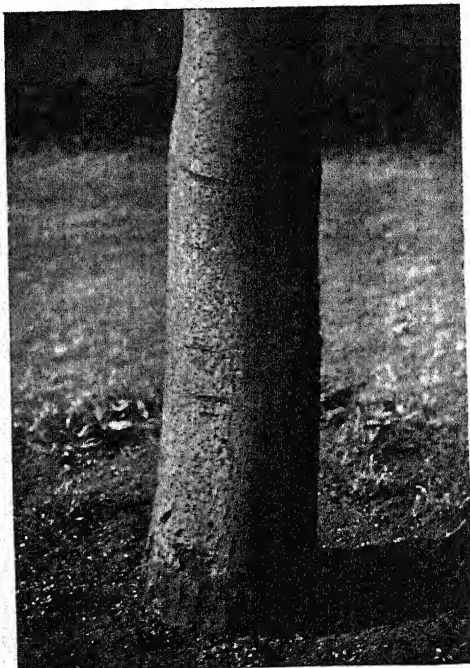
The greyish



AN APPLE ORCHARD IN BLOOM.

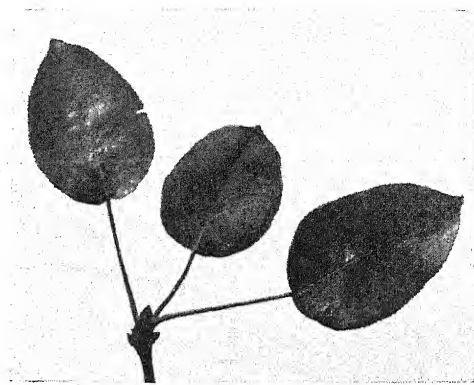


TRUNK AND BARK OF WILD PEAR.



TRUNK AND BARK OF WHITE BEAM.

brown bark is scaly. The twigs are smooth, and of a reddish brown. There are many dwarf shoots with ringed scars. The buds are small, and protected by scales on which are some whitish hairs. The leaves vary in form from a rounded to a long oval. They show distinct serrations along their margin, and have pointed tips. Five or six pairs of strong secondaries branch off from the midrib, and curve forwards, but they soon divide. The flowers grow singly on short stalks, several of which emerge together at the tips of the dwarf shoots, or spurs, and, spreading outwards, form bunched clusters. The five petals to each flower are pink and white, and within the cup formed by these is a circular group of many stamens, each with a creamy yellow head, erect after the second day of opening. The familiar rounded fruit shows always a



LEAVES OF WILD PEAR.

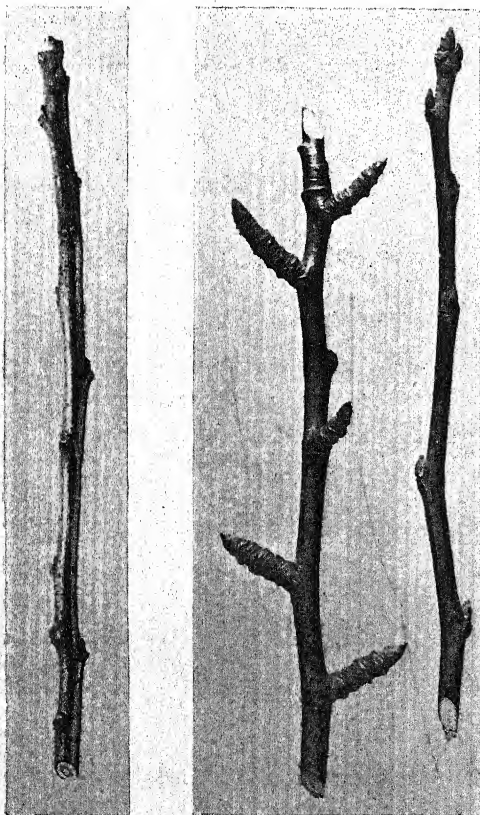
distinct depression at the base where the stalk enters, as well as at the top where the calyx is still attached. The firmly coated brown seeds, or "pips," in pairs, are disposed in five separate walled cells, which constitute the Apple's "core."

THE WILD PEAR

This is not a common tree, and is probably often a mere escape from cultivation. In comparing it with the Wild Apple the following details may be noted.

The shape of the tree is usually taller and less spreading. The branching is more open, and with less entanglement of the twigs. The bark is more distinctly furrowed, and less inclined to flake off in scales. The twigs are a yellowish brown, and are without hairs. The buds are hairless. The leaf margins show only ill-defined serrations. The venation of the leaves is less distinct, the secondaries, though more in number, are weaker and more sinuous, the whole system breaking up into a more or less complete network of nerves.

The flowers are, with rare exceptions, pure white. They open about ten days before those of the Apple. They are grouped in more distinct and more open bunches. The many stamens stand erect from about the third or fourth day after the petals have expanded, and their tops are a dark purple. The fruit, notwithstanding our familiar use of the term "pear shape" as a descriptive epithet, is frequently round, but it may be readily distinguished by the absence of any depression at its base.



1
2
TWIGS (1) OF THE APPLE; (2) OF WILD PEAR
SHOWING BUDS AND DWARF SHOOTS.

Moreover, the substance of the pear has always a gritty admixture, instantly recognised on cutting or biting.

It will be convenient to regard the next three trees as forming a sub-group. Their flowers, which are small and white, or creamy white, are borne in branched clusters, in such a way that the flower heads arrange themselves more or less in a single plane. The fruits, popularly spoken of as berries, are like miniature apples, varying in colour according to the kind; they are grouped in the same manner as the flowers. They enclose but few seeds.

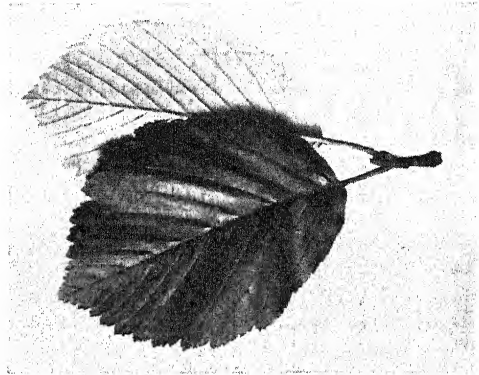


TWIG OF
THE WHITE
BEAM.

perhaps, appears as a considerable bush-like tree, with several strong stems spreading upwards from the base.

The grey bark is at first smooth, having dots arranged in short transverse lines. This eventually becomes rough. The twigs are stout, and shining, brown to grey in colour. The buds, spirally

arranged, usually stand out from the twig. They are protected by scales, which are green with brown margins. The leaves vary in shape, and have a tendency, more or less decided, to divide into pointed sections, with double serrations on the margin. When young they are grey. On first emerging from the bud they stand up like small grey, or white, pinnacles. After full expansion the upper surface becomes gradually a deep shining green, but the lower surface



LEAVES OF THE WHITE BEAM.

remains white, being coated as with thick felt. It is this under-surface whiteness, lifted and displayed by the wind, which gives to this tree its distinctive character and name as the White Beam. The calyx and stalks of the flowers are coated with this same white felt. The petals of the flowers are white, as are also the tops of the stamens. The fruit is nearly globular, and its colour is scarlet, often dotted with brown.

As a shrub the White Beam may be distinguished, with certainty, from the rather similar shrub known as the Wayfaring Tree, by the spiral arrangement of its buds and leaves. Those of the Wayfaring Tree are opposite.

HENRY IRVING.



CONCERNING THUNDERSTORMS—I

By WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.

"We often see, against some storm,
A silence in the heavens, the rack stand still,
The bold wind speechless, and the orb below
As hush as death: anon the dreadful thunder
Doth rend the region."

SHAKESPEARE (*Hamlet*).

EVERY one of my readers has had an opportunity of witnessing in this country the fine display which a thunderstorm presents — when Nature seems to be turned loose for a time. The storms which we experience in these Isles are, however, veritable pigmies when we come to compare them with those that are born and bred in tropical regions; nevertheless, many of us have often felt considerably alarmed even when compelled to be present at the advent of these minor types of atmospheric disturbances.

In spite, however, of the dangers which may accrue from violent thunderstorms, the lover of Nature should welcome their approach. Is there not majestic grandeur in the enormous cumulus cloud which composes the storm, folds and folds of which soar skywards? Is there not interest in the rapid movements in several directions, both horizontally and vertically, of the air currents as indicated by the ever changing positions and forms of the cloudlets? Is there not beauty in the fine gradations of colours—blue, mauve, violet, etc.—as the storm approaches? And, lastly, is there not wonder, perhaps mixed with awe, in the magnificent display of Nature's untied energy as exhibited by the intensely dazzling flashes of lightning and the accompanying, or, rather, subsequent, peals of thunder which reverberate through the air?

With such objects of interest and study before us, some best seen by day and others when the storms occur during the night-time, no opportunity of watching them should be missed. In this way a

thunderstorm, which many people look upon as a nuisance, to be dispensed with as soon as possible, may become a thing of beauty, and worthy of the closest attention.

It is a curious fact to note that an atmospheric disturbance such as a thunderstorm—in which torrents of rain fall, heavy squalls of wind are experienced, and almost incessant lightning and thunder occur—is, after all, the result of a very peaceful and serene state of the atmosphere about us.

Most of us can recall one magnificently fine summer's day when Nature seemed nothing but smiles for us, and appeared to be doing her best to make everything as ideal as possible. We can all remember also how our confidence in her received a rude shock by the quick approach of a thunderstorm, which converted serenity into chaos!

When one, however, begins to observe closely, and tries to find out the inner working, so to speak, of Nature's procedure, one is led to the conclusion that there is a greater number of steps in the process of the formation of a thunderstorm than one might at first think, and they are of the greatest interest to watch.

Let us for a moment pass in review the general sequence of changes which are experienced as a storm approaches and passes over an observer during the day-time. By careful watching it will be seen that the blue sky gradually becomes covered with a layer of thin cloud, usually termed cirro-stratus, at a great altitude. This very elevated cloud form

precedes the storm, and may be from ten to fifty miles ahead of it. As time passes, underneath this layer will next be observed thick dark grey and violet coloured clouds of the cumulo-stratus type, and after that grey or ruddy clouds at a still lower elevation. The approach of the main cloud of the storm will now be seen in the distance, and as these low clouds begin to pass overhead, they are seen to be rounded underneath and to have a billowy appearance. The wind begins to rise in strength, and the direction from which it blows becomes reversed. The wind now takes the nature of a squall; but this is short-lived, and is followed by a deluge of rain. Already distant lightning has been dimly seen, and thunder heard; but the storm now bursts over the position of the observer,

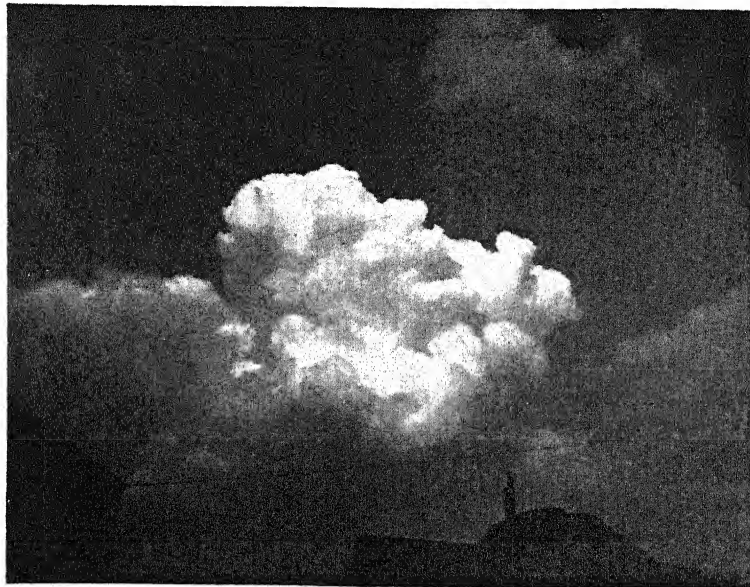
and is accompanied by numerous brilliant flashes and the loudest of thunder claps. The flashes, owing to the fact that it is still day-time, do not, however, appear so intensely bright as they would if the storm had taken place at night.

The moment of the bursting of a thunderstorm is well expressed in the following lines from the "Ingoldsby Legends":—

"And then a hollow moaning blast
Came, sounding more dismally still than the last,
And the lightning flash'd, and the thunder growl'd,
And louder and louder the tempest howled,
And the rain came down in such sheets as would stagger a
Bard for a simile short of Niagara."

For some time rain continues to fall in great abundance; but the times of greatest rainfall vary, sometimes being near the beginning and sometimes toward the end of the storm.

Behind the storm the horizon now becomes lighter, clouds in that region are seen detached, and later on blue sky is visible once more. The rain ceases as the last of the storm-cloud passes over-

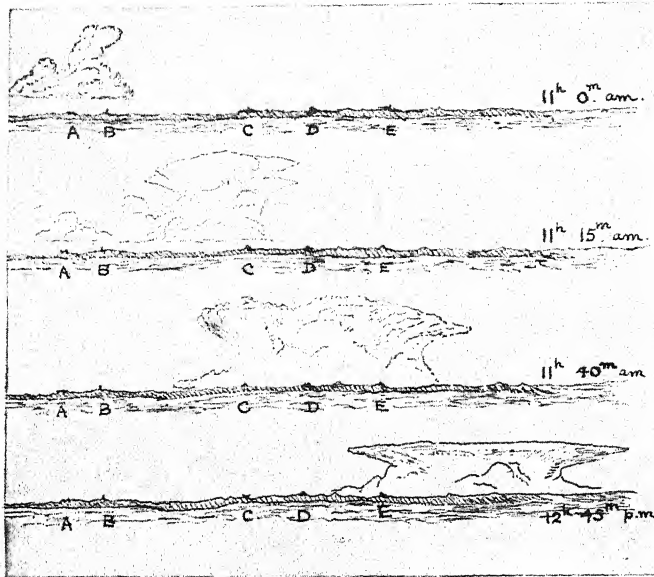


"ITS EXTREME WHITENESS . . . RENDERS IT A STRIKING OBJECT."
An embryo thunder-cloud photographed by Dr. Lockyer at South Kensington in 1906.

head. The landscape now emerges from gloom to light, the air feels fresher, the temperature, which has been lowered, rises again, and once more serenity prevails.

Thunderstorms, when they come singly, do not last very long, the length of time between the first and last sounds of thunder being on an average about two hours. Very often, however, thunderstorms occur in series, and when one is over another follows in its wake. In some regions, generally owing to the peculiar configuration of the surrounding country, the thunderstorm recurs and passes over the same locality again.

Having now recalled to memory the general features connected with the approach and departure of a "grown up" thunderstorm, let us now consider



THE GROWTH AND MOVEMENT OF A THUNDER-CLOUD, AS OBSERVED AND DRAWN BY PROF. W. M. DAVIS, AT NEW YORK, JULY, 1887.

the storm from its birth to its fully-fledged state.

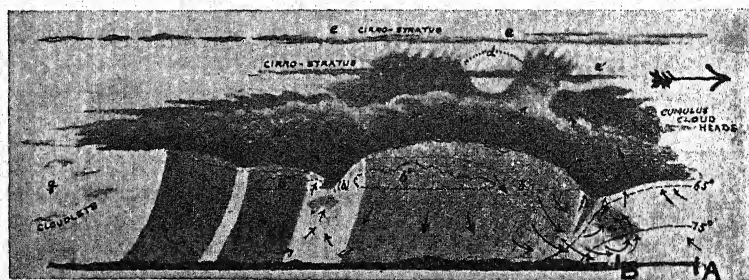
In these islands thunderstorms are due to excessive heating of the air at the earth's surface, which causes up-currents of air to rise into the higher regions of the atmosphere. It is only natural that these storms occur most frequently in our summer months, for then the sun is longer above the horizon, higher in the sky at midday, and therefore under the best conditions to heat the earth's surface to an excessive extent.

The rush of warm and moist air into more elevated and cooler regions gives rise to cloud, for there the air is cooled and the water vapour is condensed. Such a cloud is termed a "cumulus" cloud, because it has a heaped-up appearance like a tuft of wool. Now, such a cloud forms the embryo of a thunderstorm. It is at first small, but the con-

tinued ascent of the moist warm air makes it in time assume enormous proportions. To watch such a cloud grow in size is of the greatest interest and beauty, for it usually begins to form in a cloudless sky, and its extreme whiteness, with a background of blue, renders it a striking object. As its dimensions increase, fold upon fold tower one upon the other on the upper surface. Such an embryo thunder-cloud is seen in the illustration on page 619, which is from a photograph I secured at South Kensington in the spring of 1906. This cloud, before it passed out of

sight, grew to considerable dimensions, the billowy masses rolling upwards tier upon tier, giving it a magnificent appearance.

In the initial stages of formation a thunder-cloud has a flat under surface and a billowy top. It, however, undergoes considerable changes before it can be stated to be properly developed. Perhaps the best idea of these transformations will be gathered from a very interesting series of drawings which were made by a distinguished American meteorologist, Professor William M. Davis, and here reproduced. These drawings show the increasing size and change of form of the thunder-cloud which passed over New York on July 2,



PROF. KÖPPEN'S DIAGRAM OF A VERTICAL SECTION OF A THUNDERSTORM.

1887, and they illustrate at the same time the progressive movement of the cloud over the land.

Looking at the first of the four sketches, the cloud will be observed to be over positions A and B, and to be an ordinary cumulus cloud at eleven o'clock. By 11.15 it had grown considerably, both vertically and laterally, and it will be noticed not only to have travelled to C but to have extended its uppermost front in the direction of travel. At 11.40 its base had decreased in height and its uppermost front and back portions assumed a mushroom or overhanging appearance. The cloud was then over the positions C, D, and E.

In the last drawing, made at 12.45, or more than one hour later, it had nearly passed over E, and assumed

the typical form of a well developed thunder-cloud, namely, a form something like an anvil.

When one considers the great mass of cloud involved, the large area over which it extends, and the comparatively small altitude of the under surface, it is not surprising that considerable darkness prevails on the surface over which the storm travels.

The study of a thunder-cloud, with its attendant winds, would not be complete without a brief reference to a very instructive diagram (on the opposite page) which sums up the main facts above described. We owe this diagram to the celebrated German meteorologist, Professor Köppen. This vertical section of a storm displays the anvil-shaped form of the whole mass. It

indicates, further, both the high and the low clouds, including the very elevated cirro-stratus cloud, which, as previously stated, considerably precedes the front of the storm. It will also be noticed, by observing the small arrows (which blow with the wind) near the front of the storm, that as the whole storm moves from left to right, the observer at A, who is stationary, will think



THE FRONT PORTION OF A THUNDER-CLOUD MOVING FROM LEFT TO RIGHT.

Photographed by Dr. Lockyer at Sandown, Isle of Wight, in Aug., 1906.

that the storm is coming up against the wind. As a matter of fact, the observer is only in a large current of air which flows in towards the base of the storm-cloud, and must therefore blow in the opposite direction to that in which the storm is travelling. When the storm has moved on a little, and the observer is at position B in relation to it, he will then feel the full blast of the storm, the wind here being in the same direction as that in which the storm is travelling.

These apparently opposing wind currents which exist near the front of the storm thus clearly explain the very common statement that a thunderstorm comes up against the wind.

The accompanying illustration shows the profile view of the front portion of a thunderstorm as it moved from left to

right in the picture. This view was taken by me at Sandown, Isle of Wight, in August, 1906, the camera being pointed eastward, and the storm moving from north to south.

The overhanging nature of the front of the storm-cloud is clearly discernible, but the main lower part of the cloud

was outside the field of view. In the upper right-hand portion of the illustration, up to the edge of the overhanging storm-cloud, light cirrus cloud and blue sky were visible, but the former was too delicate to be photographed with the apparatus at my disposal.

W. J. S. LOCKYER.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.

With Photographs by HENRY IRVING

THE FLOWERS OF THE CHALK DOWNS AND PASTURES

A WALK on the downs will bring us into touch with many flowers that will invariably be found in such places; some of these will also be seen growing elsewhere, but generally the down-land is so poor, and has such a small depth of soil, that the plants are frequently dwarfed and half starved, and consequently may not be recognised. This is not the case everywhere, for some downs have greater depth of soil and more moisture for the plants to feed on, and under these conditions they will then grow to the ordinary size.

For instance, I frequently come across many specimens of the Field Scabious—which generally grows between one and three feet in height—certainly not more than two inches high and with the blossoms only half the usual size. In the pastures we do not find this dwarfing to the same extent, and many of these are rich hunting grounds, and produce several interesting, and not very common, plants.

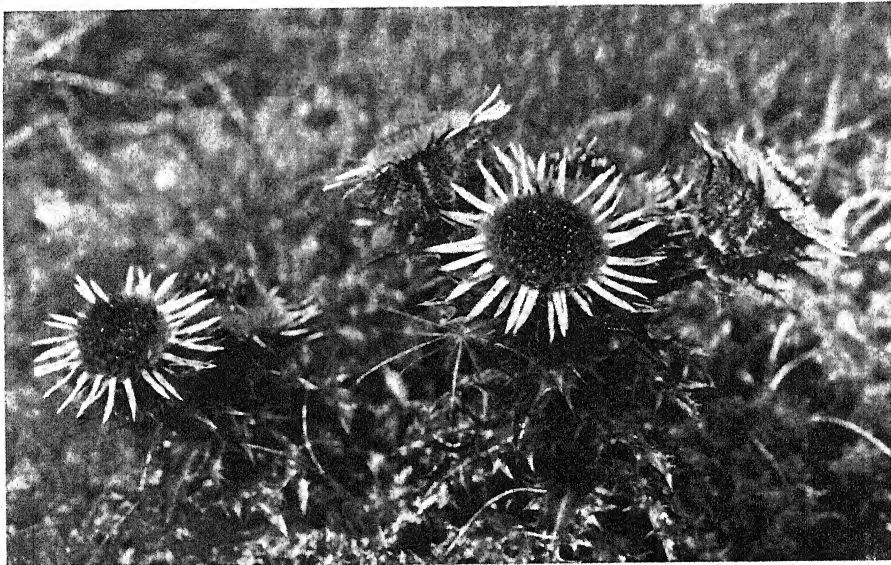
THE DWARF PLUME THISTLE

In finding a resting place on the downs one has to be very careful sometimes in selecting a spot whereon to sit, for the Dwarf Plume Thistle (*Carduus acaulis*) has a habit of spreading its very prickly leaves so that it covers a great deal of

ground. This thistle is easily distinguished by the lack of stem, its spreading rosette of very prickly, pinnate leaves, in the middle of which appears a rather large, purple flower head. All the Thistles belong to the family of Composite plants (*Compositæ*); the flower heads are a collection of florets, all of which are tubular in shape. These are succeeded in the late summer and early autumn by masses of white, feathery down. This plant is not found in the north of England; it flowers from July to September.

THE CARLINE THISTLE

The Carline Thistle (*Carlina vulgaris*) is not by any means confined to the chalk downs, although it is generally to be found growing thereon, and for this reason it is included in this section. All the Thistles bear purple florets, but this one possesses so many yellow bristles that the purple colour is not so noticeable; this characteristic will make it easy for anyone to recognise it. The whole plant is generally about six or eight inches high, but, on the downs, it is very often quite dwarfed, and not more than one or two inches in height. The lower leaves are narrow, spread flat on the ground, and covered on the under sides with white, cottony wool; the upper ones are broader



CARLINE THISTLE.



DWARF PLUME THISTLE.

and have no wool; all the leaves are spiny. The flower head itself is surrounded by brownish yellow bracts (these are also spiny) which give the whole flower a somewhat dried-up look; these

name; Prior considers that it is, in all probability, a corruption of some other word, perhaps Heather Bell. The name *Campanula* means a little bell, and comes, of course, from the shape of the flower.

When the plant is seen growing, the amateur botanist may wonder why it is called the Round-leaved *Campanula*, since all the leaves that are to be seen are small and narrow. The explanation will be found by digging up a young plant carefully, or else by scraping away the grass which is growing around the thin, wiry stem just where it joins the ground, for then a few round or heart-shaped leaves, coming up from the roots, will be seen; these wither when the plant is in flower. The flowers secrete honey at the base, and are much sought after by insects. The hanging position of the blossoms serves to protect the honey from the rain, and the fact that the sensitive part of the stigma is turned downwards, prevents the pollen falling on to it, and so self-fertilisation is avoided. This plant is the true Blue-bell of Scotland.



HARE BELLS.

bracts keep their form and colour long after the florets have bloomed.

The name *Carlina* (or *Carolina*) comes from the tradition that the root of *Carlina acaulis*, another member of the genus, was shown by an angel to Charlemagne as being a remedy for the plague that was devastating his army.

THE HARE BELL

One of the most graceful and delicate of plants is the Hare Bell (*Campanula rotundifolia*), a general favourite amongst our wild flowers. It is impossible to say what is the origin of the common English

CLUSTERED BELL FLOWER

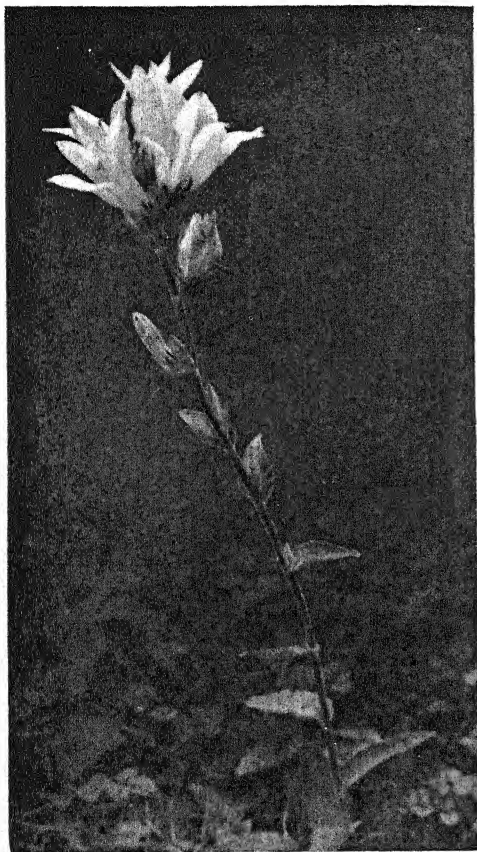
A near relation to the Hare Bell is the Clustered Bell flower (*Campanula glomerata*), which is to be found growing in dry pasture land. This plant sends up a stiff, erect stem, about a foot high—often dwarfed to about three or four inches—generally covered with stiffish hairs; the lower leaves are stalked, but the upper ones clasp the stem; all of them are rough and hairy. At the top of the stem is a cluster of dark blue bell-shaped flowers, but they are not pendulous as in the case of the Hare Bell. One or two flowers will also be found singly or in pairs below the terminal cluster. None of the flowers have stalks; they grow out of the stem, in the axils

of the leaves. The Nettle-Leaved Bell flower (*Campanula Trachelium*), a photograph of which is given for comparison, grows more frequently in woods, and is different in general appearance; the flowers are shortly stalked and have a

ably to keep small insects from creeping down into the tube and stealing the honey.

YELLOW-WORT

A very striking plant, the Perfoliate Yellow-wort (*Blackstonia perfoliata*) is



CLUSTERED BELL FLOWER.



NETTLE-LEAVED BELL FLOWER.

more pendulous habit, although sometimes they are gathered into a terminal cluster as in *Campanula glomerata*. The leaves are coarsely toothed, and are very similar in appearance to those of the Stinging Nettle.

Another little dark blue flower to be found on the downs is the Field Gentian (*Gentiana campestris*), which, in these localities, appears as a small bunch of dark blue flowers and leaves with scarcely any stems. All the parts of the flower are in fours, and the mouth of the corolla is furnished with a fringe of hairs, prob-

ably to be seen growing in dry pastures, especially in chalky districts. It is a member of the Gentian family, and may readily be recognised by the fact that its leaves grow in pairs, and are so connected at their bases that the pale sea-green stem appears to be growing through the middle of one leaf, whence the name *perfoliate*. At the summit of the stem are a few bright yellow flowers, with all their parts in eights; the calyx has eight lobes or divisions; there are eight lobes to the yellow corolla, and eight stamens. Both the stems and leaves

are of a glaucous, sea-green colour, and altogether it is a plant which is so distinct from others that it should be at once recognised. Like the Dwarf Plume Thistle, this plant does not extend beyond the central and southern portions of England; it is to be found in flower from the end of June to September.

BEE ORCHIS

Never shall I forget finding the Bee Orchis (*Ophrys apifera*) for the first time. It was in a dry field, just under one of the chalk downs in the Isle of Wight, growing in great abundance, together with the Perfoliate Yellow-wort—which plant I also saw then for the first time. The family of Orchids, all the world over, produces many of the most interesting plants that are known. Their peculiar shapes, colouring and construction all tend to make them noticeable.

The stem of the Bee Orchis grows as much as eighteen inches high in a good locality, and bears a few oblong leaves near the base, and a few rather large flowers towards the summit, each one with a leafy bract. The whole of the flower bears a distinct resemblance to a big bee on the wing, the "lip" being of a rich velvety brown, very downy on the sides, and marked by paler lines and spots; the outer sepals are prominent and pale pink or greenish white. The mimicry of nearly all the Orchids appears to have the especial object of attracting certain insects and birds with a view to securing the transference of the pollen from one plant to another, but in the case of the Bee Orchis this does not seem to be the case. Self-fertilisation appears to take place in almost every instance, for the pollen is contained in pear-shaped masses, which, at the proper time, drop out and hang directly over the stigma, so that the slightest breath of air is sufficient to bring them in contact. What, then, can be the reason for this curious mimicry? One botanist has suggested that this resemblance to the bee was to prevent insects visiting the flowers, but Darwin—who devoted a special book to the various methods of orchids to secure fertilisation—believed that the mimicry served to secure an occasional cross. Neither of these explanations is very

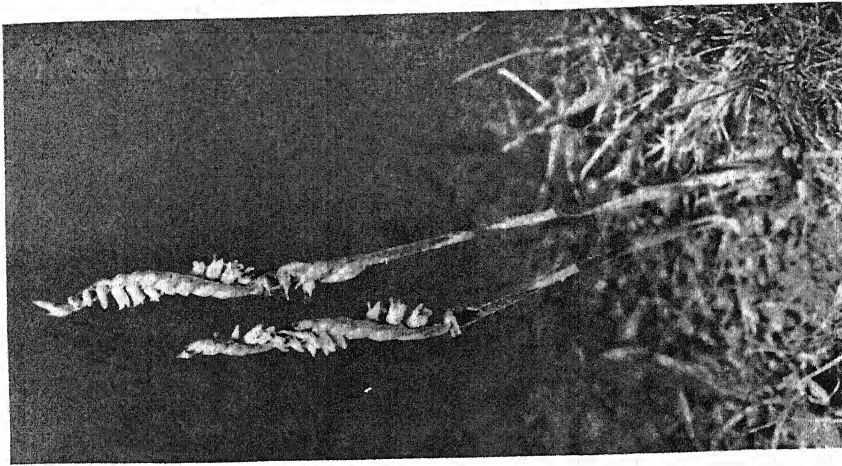
satisfactory. It is hard to imagine that the plant has taken such pains for, it must be some hundreds of years, to arrive at this stage, and has attained no special object by doing so. Is it only a freak of nature, and not an instance of mimicry at all? The name *Ophrys* comes from a Greek word signifying an eyebrow. Pliny states that a member of this genus was used in ancient times to darken the eyebrows.

LADY'S TRESSES

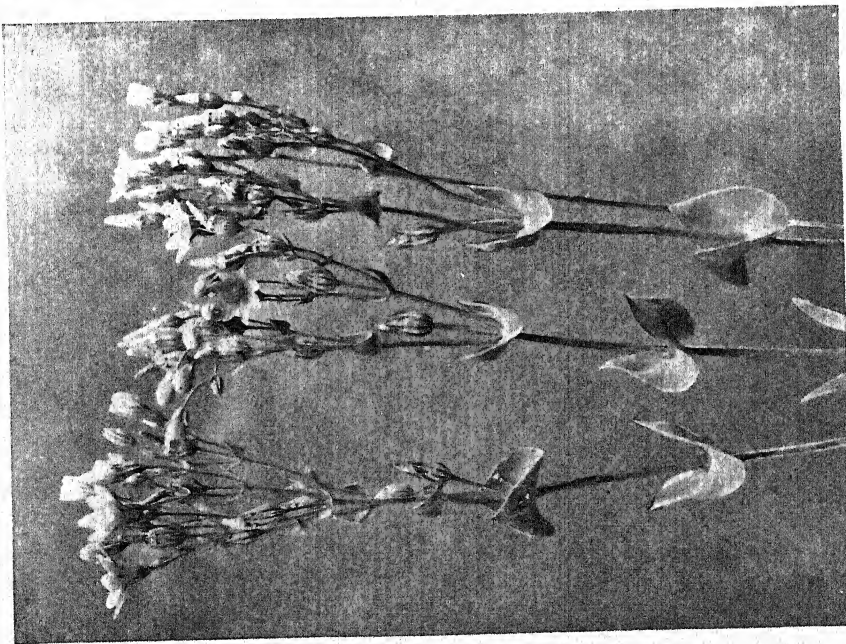
The Lady's Tresses (*Spiranthes autumnalis*) is another representative of the Orchid family to be found on the downs and on dry, upland pastures. It flowers somewhat late in the year, and should be looked for in September and October. Identification should not be difficult; the photograph shows well the peculiar spiral arrangement of the blossoms on the stem. The flowers are white and fragrant, and at the base of each is a leafy bract, which remains upright on one side of the stem, while the flower diverges horizontally to the other side. The broad leaves grow in a tuft at the base, and the flowering stems appear by the side; up the stem will be seen short, pointed leafy scales.

ROCK ROSE

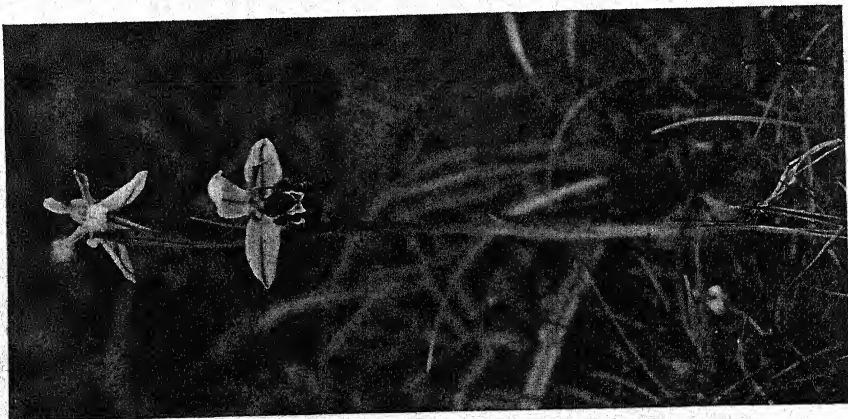
A fairly common plant, which is to be found in summer and early autumn growing in dry pastures, especially in chalky and gravelly districts, is the Rock Rose (*Helianthemum Chamæcistus*). It possesses somewhat woody stems, which trail along the ground and send up erect flowering branches; the lower portions of the stem are smooth, frequently hairy, and of a reddish colour. The leaves grow in pairs, but are somewhat irregular and become smaller as they approach the flowers; they have short footstalks, and roll their edges backwards; the underneath is grey, from a fine coating of down. The bright yellow flowers, with rather crumpled petals, are borne in a loose raceme, the flower stalks being slightly bent downwards both before and after flowering; there are five green sepals, three of which are larger than the other two—each of these has three ribs and is nearly transparent, and concave in shape; the other two sepals are very small. These flowers, beautiful as they



LADY'S TRESSES.



PERFOLIATE YELLOW-WORT.



BEE ORCHIS.



VIPER'S BUGLOSS.

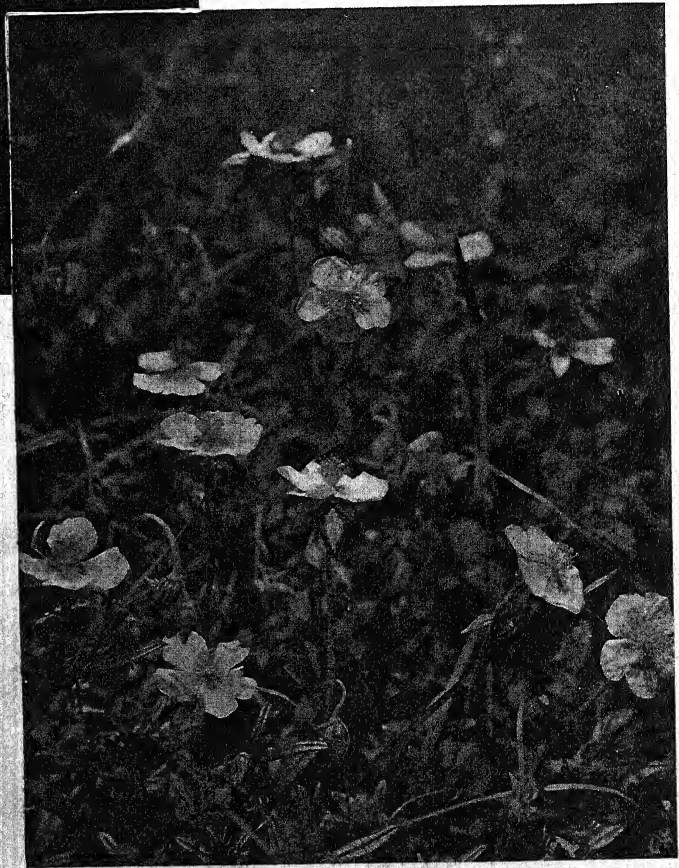
are, are of no use for picking, as they close almost immediately; anyhow, their life is a very short one, which fact has given rise to the names "Day's Eye" and "Sunflower."

VIPER'S BUGLOSS

The Viper's Bugloss (*Echium vulgare*) is another plant that is fond of chalky pastures, although it is by no means restricted to these localities. This plant is a robust relation of the Borage, and is one of the handsomest of all our wild

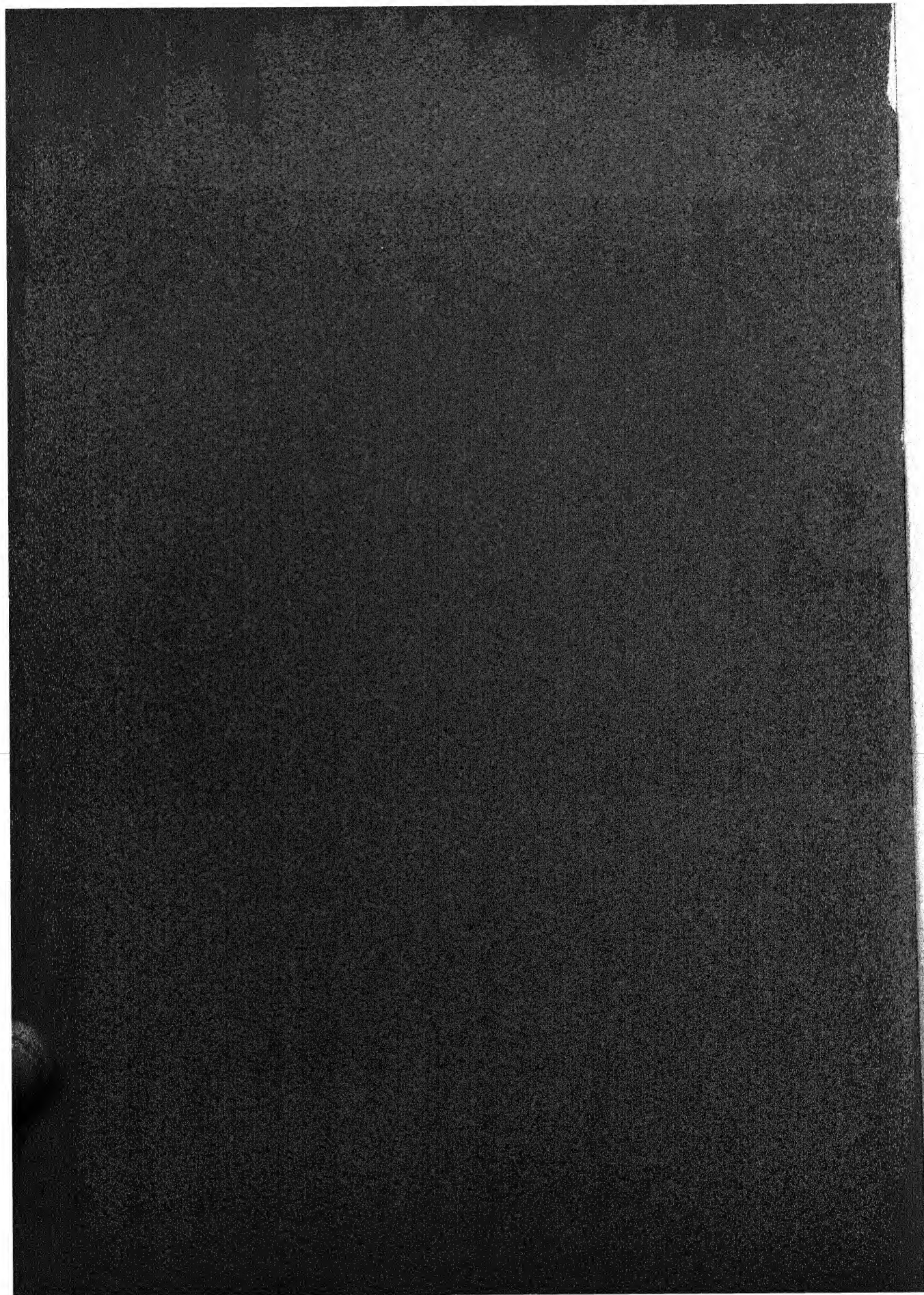
flowers. It often grows between two and three feet high. It bears a long, one-sided, flowering spike, with flowers of a reddish purple colour when they first emerge from the pink bud; afterwards they turn a beautiful bright blue; the flowers appear in June and July. The leaves are rough and hairy, and this has given to the plant the name Bugloss, which is derived from two Greek words, signifying an ox's tongue; the Latin name, *Echium*, means a viper. The reason for this name is a little obscure; it may be that the plant was supposed to be an antidote for a snake's bite, or because the stem of the plant is speckled like a viper's skin.

H. PUREFOY FITZGERALD.



ROCK ROSE.

A WARWICKSHIRE COTTAGE
FROM THE PICTURE BY A. C. WILKINSON



HOW TO KNOW THE INSECTS

By JOHN J. WARD

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.

IN WINTER QUARTERS

With Photographs by the Author

WITH the retreat of the sun's warmth as November draws near, our insect friends daily decrease in numbers, and the tyro who, throughout the summer months, has been diligently endeavouring to understand their curious, fascinating, and often extraordinary habits, becomes sorely puzzled as to what has become of them. That they must still be in existence is obvious, for he knows that in the following season they will appear again in their own particular environment, and carry on their activities just as if no interval had occurred.

In this concluding chapter of the present series, I propose, therefore, to consider some winter aspects of insect life, dealing more particularly with the insects already considered in their summer stages.

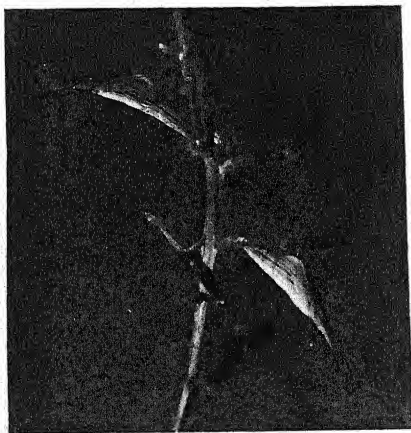
Regarding the butterflies illustrated in this work, I have previously mentioned that the Small Tortoise-shell, the Brimstone, and the Peacock spend their winter hibernating as winged butterflies (see pp. 49, 216, and 494), their frail forms enduring cold and frost until the arrival of more congenial temperatures. The Green-veined White Butterfly (see pp. 211 to 213) behaves quite differently, however, during the winter months. Just before winter the full-fed caterpillar climbs the

garden wall, or a wooden fence; in the former case it usually comes to rest in the groove of the coping-stones, moulting its skin and so changing into its chrysalis stage, and there resting sheltered from rain and cold winds until better days again come. A search round the garden wall will nearly always reveal a few chrysalides of this species,

and still more often those of the Small White and the Large White butterflies, which select similar places for their winter quarters. When a wooden fence is selected the chrysalides are usually found between the angles of the palings.

The Orange - Tip Butterfly, in its caterpillar stage, as we have previously seen (p. 47), largely resembles the seed pods on which it feeds, and, probably because this mimicry

proves so effectual, the insect finds it profitable to carry this same device into its chrysalis stage. On this page two chrysalides of this insect are shown attached amongst the seed pods, and the photograph will make clear how closely they resemble their surroundings. At first they are green, but as the seed pods become brown the chrysalides also assume that colour. In this way they retain the closest resemblance to the plant, and in spite of the heavy snows and rains and



TWO CHRYSALIDES OF THE ORANGE-TIP BUTTERFLY.

Showing how they resemble the seed pods.

freezing temperatures, in early May a delicate butterfly clothed in white and mottled-green (or, if a male insect, also



A FEMALE CHALK-HILL BLUE BUTTERFLY.

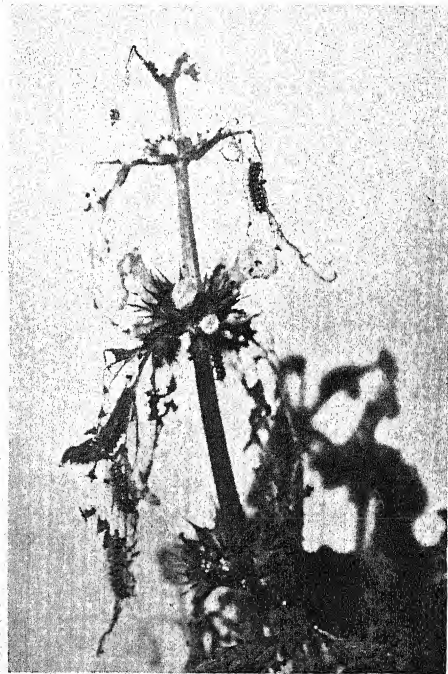
in bright orange hues), bursts forth to greet the early sunlight.

Both the White Admiral and the Silver-washed Fritillary butterflies (previously considered, pp. 127 and 255) spend the winter period as tiny caterpillars hidden amongst the leaves of their food plants. The same may be said of the Chalk-Hill Blue Butterfly (*Lycæna corydon*), illustrated on this page; the photograph shows the female insect.

The elegant butterflies known as the Blues are always attractive, though they are small in size when compared with those species I have considered earlier. In the males the wings are generally bright blue above, but in the females they are usually brown tinged with metallic blues or purples. Sometimes the sexes are so different that they would hardly be taken for the same species. There are several genera of these insects, and experts are often puzzled to make quite sure of the identity of the various

species. The large size and the pale silvery-blue of the upper side of the wings, which are also edged with black, will usually distinguish the male Chalk-Hill Blue as it flies in the chalk districts; from this latter characteristic it derives its popular name.

Turning to moths, we may first consider the Black Arches (illustrated p. 214), for this insect winters in a remarkable manner. In July the female insect deposits her numerous eggs in suitable situations amongst the crevices of the bark, and about the newly formed buds. In these situations the eggs remain for the rest of the summer and throughout the autumn, winter and a part of spring—until early in April of the following year. The curious feature is, however, that the little caterpillar makes its appearance within the egg late in autumn; its



"WOOLLY BEARS" AS THEY APPEAR JUST BEFORE WINTER.

variously coloured body (see illustration p. 130) may be seen coiled up through the transparent shell, though it does not break the shell to emerge until April.

Such is an unusual method of hiber-

INSECT LIFE

HARMFUL INSECTS

Specimens required :—

1. PINE BARK SHOWING BEETLE BURROWINGS
2. LARVA OF GOAT MOTH,
3. WIREWORMS AND CLICK BEETLES
4. GRUBS OF CHAFER BEETLES

1. Burrowing Beetles

Note bark eaten out by beetle grubs. Notice the main gallery and smaller ones leading from it. Observe small holes showing place of exit of beetle after the change from the grub. Eggs are laid at intervals along the main gallery, and the grubs eat outward. Note reason—*viz.* so that each receives a full supply of food.

2. Wood-boring Larvae

Note structure of Goat Moth larva, especially noting its strong jaws. Observe that it feeds on wood. Since it spends several years in the larval state it causes enormous injury to tree life. Another good example is the Leopard Moth larva.

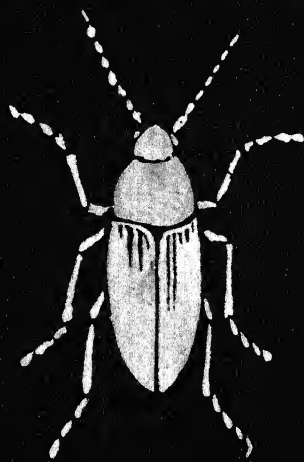
3. Wireworms

These may be obtained from infested land by trapping them in a potato tuber. Note segments and tenacious build of the worm, which is really the grub of the Click Beetle. The Wireworm causes great damage to roots. Other examples of root-eaters are the larvae of Cabbage Moth.

4. Beetles

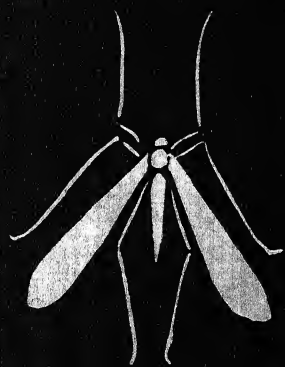
Note grub of Cockchafer Beetle. It possesses powerful jaws, which cause great damage to roots. Observe the jaws of the beetle, which is well known for the great harm it does to foliage.

HARMFUL INSECTS

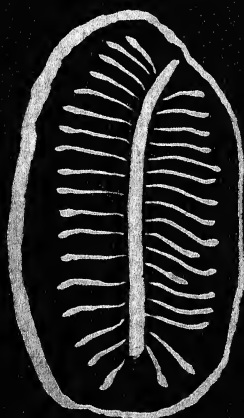


click beetle
and
larva.

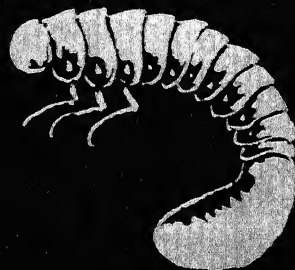
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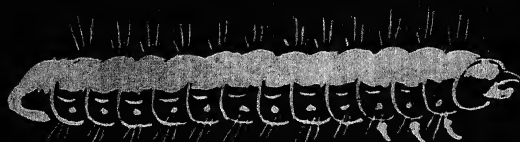
Crane Fly



Borings of grub of
Beetle in bark



Grub of
Chafer beetle



Larva of Goat Moth
(wood eater)



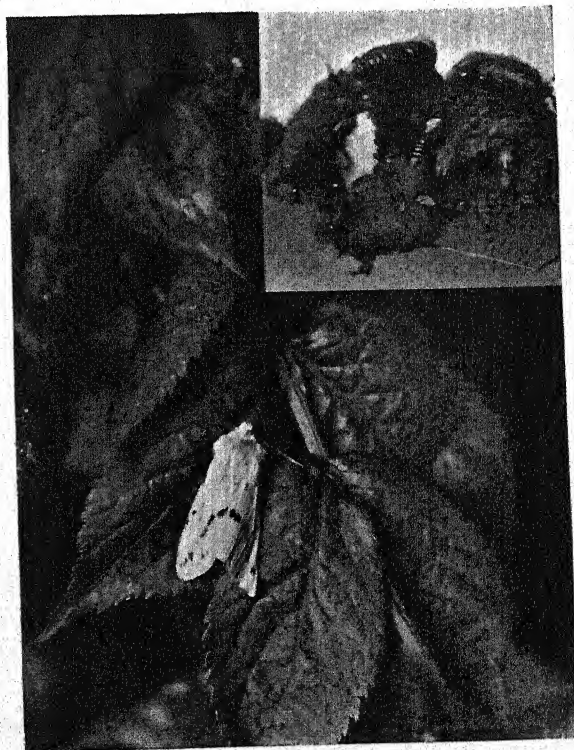
COCOON AND CHRYSALIS OF THE PALE
TUSOCK MOTH.

nating amongst moths; more often the caterpillars emerge from the eggs and feed for a little time during the autumn, then hide among leaves for the winter. This method is adopted by the larva of the Drinker Moth (p. 45), and also by the "woolly bear." On page 630 some of the latter caterpillars are shown as they appear just before winter, and while on their favourite food plant, the white dead-nettle; the full-grown larvæ were illustrated on page 48. The Narrow-bordered Five-Spot Burnet Moth (illustrated p. 258) behaves very similarly. The quaint stick-like caterpillars of the Swallow-tail Moth (illustrated p. 50) also spend the winter as larvæ, but they are usually about half grown before winter commences, hiding away in sheltered corners amongst the bark and branches, and trusting for protection to their close simulation of their surroundings.

The Cinnabar Moth, whose larvæ were illustrated on page 259, is during winter a brown chrysalis resting amongst the grass near the surface of the ground. The Buff-

tip Moth (shown p. 215) may be found also in similar situations, but generally amongst fallen leaves; as its chrysalis is quite bare, it is often exposed when wind or other agencies have disturbed the leaves. The chrysalides are especially abundant round the base of elm trees.

Then there is the Pale Tussock Moth, whose emergence from the chrysalis was illustrated on page 73. On this page a still earlier stage is shown, as the insect appeared before winter. Late in September the caterpillar attaches together one or two oak leaves, and then proceeds to denude itself of the tufts of hairs that clothe its body. With the hairs it weaves a kind of warm and thick felt, which serves to protect it both from cold and wet and also from its enemies when it becomes a chrysalis. In the illustration I have removed the chrysalis from the cocoon to exhibit its form; the chrysalis itself is slightly hairy. So in the chrysalis stage, the moth waits until

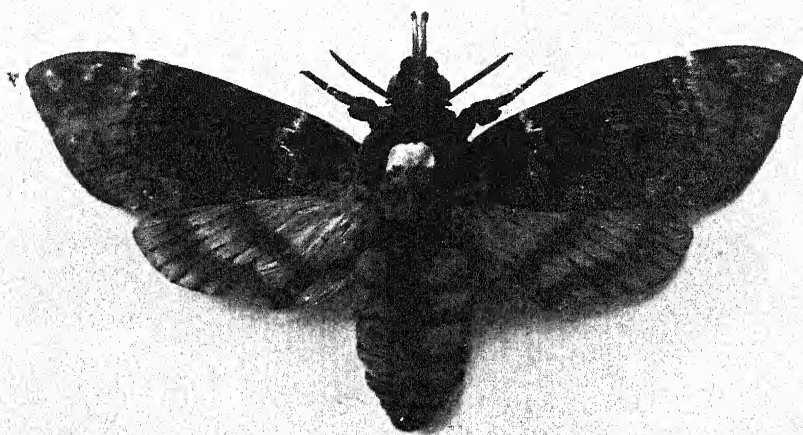


BUFF ERMINE MOTH.
With cocoons and chrysalides.

about early May, when it emerges from its chrysalis and cocoon to develop its wings as previously explained.

Another pretty moth with similar habits, and one which readers of THE NATURE BOOK may have frequently seen during the summer months, is that illustrated on page 631, the Buff Ermine Moth (*Spilosoma lubricipeda*); an insect with creamy yellow wings spotted with black. As

this country the insect is generally scarce, but occasionally, for some peculiar reason, it occurs in comparative plenty in various districts, and perhaps it is more common now than formerly. It derives its popular name from the curious skull-like marking on the back of the thorax, which shows well in the illustration. Another remarkable feature of the moth is that, when captured, it will often make a peculiar squeak-



DEATH'S-HEAD HAWK-MOTH.
The largest British moth.

autumn advances the caterpillar of this moth becomes full-fed, and with the hairs from its body forms a cloth-like covering that envelops its chrysalis. Some of the chrysalides are shown in the upper part of the illustration; they are usually found near the surface of the ground.

I have previously described how the Lime Hawk-Moth passes the winter period beneath the ground (p. 74), and likewise the Poplar Hawk (p. 492). The Privet Hawk (p. 213) behaves in an almost identical manner, and to these we may now add the Death's-head Hawk-Moth (*Acherontia atropos*). This is the largest British moth; indeed it is the largest lepidopterous insect found in Europe with one exception—the Great Peacock Moth (*Saturnia pavonia-major*). The Death's-head will sometimes measure a little more than five inches in expanse of wings. In

ing noise; this peculiarity, together with the strange marking on the thorax, has given rise to much superstition in the rustic mind with regard to this insect. I need scarcely add, however, that it is quite harmless.

On page 633 the same insect is shown in its winter aspect some three or four inches below the surface of the earth. These large chrysalides are often turned up in potato fields, as the caterpillar generally feeds on that plant.

Regarding the aquatic insects I have illustrated in this work, the Pond-Skater's winter devices I have already referred to (p. 50). The Diving Beetles, illustrated on page 261, may spend the winter, as the summer, in the pond, although they are less active, and do not use their wings during cold weather, preferring the muddy bottom of the pond, where it is warmer



THE DEATH'S-HEAD HAWK-MOTH DURING WINTER.

than in the atmosphere. Otherwise they may pass the winter in the pupal or chrysalis stage, burrowing amongst the moist mud and sand on the banks of the pond, but not actually in the water. Furthermore, if the larva has not completed its development on winter's approach, the insect continues in that undeveloped state during the cold season, remaining more or less dormant at the bottom of the pond.

The graceful Dragon-fly (illustrated p. 131) likewise spends its winter as a larva in the muddy depths of the pool, the nymph or pupa leaving the water in early summer and completing its final development to the winged stage on the stems of the water weeds.

The Stag Beetle (p. 260) in winter is a larva or grub hidden within the trunk of the tree on which it is working destruction, and on which it sometimes feeds for four years. Its winged stage is probably confined to the summer season. Likewise with the Cockchafer Beetles (p. 216), which spend two or three years in their larval state, but in this case carry on their destructive work beneath the soil, feeding on the roots of growing plants; the final winter is spent in the pupa stage also below the soil, the perfect beetle appearing in the summer season.

The Giant Sirex, or "Wood Wasp" (p. 491), in its winter habits resembles the Stag Beetle, living for several years in its larval stage in the heart of a tree.

Regarding the Frog-Hopper, or "Cuckoo Spit" (p. 259), I am quite unable to say how this insect passes the winter. The complete life-history of an English species has not to my knowledge been yet investi-

gated. Here, therefore, is an opportunity for some reader of THE NATURE BOOK to attain scientific fame in a novel field.

From what I have written here, it is very obvious that the various insects have quite different methods of solving the great winter problem with which, in this country, they have necessarily to contend. Therefore, the only way in which to make sure of an insect's

winter quarters is by close observation of its movements as the cold season approaches.

Finally we may consider the beautiful Lace-wing Fly (*Chrysopa vulgaris*) shown below. The winter state of this insect was for some long time a puzzle that I was unable to solve. Entomological works seemed uniformly mute upon the point, excepting one work which stated clearly that the insect passed the winter in the larval stage. However, late in the autumn of 1905 I met with some larvae

THE LACE-WING FLY.
Below are shown three cocoons.

of these insects, and these I kept under observation. Before winter they formed some curious, almost circular cocoons, covered with a kind of white silk. Some of these are shown in the illustration attached to bramble leaves just as they were formed by the insects. The cocoons remained until June 8th, 1906, when one was opened from within, a circular cap being cut off from the top and pushed open, and so, like a Jack-in-the-box, the insect emerged. This was clear proof, therefore, that the winter stage was that of the pupa or chrysalis.

The Lace-wing Fly is a surprisingly large insect to come from so small a cocoon. Probably the readers of *THE NATURE BOOK* have frequently observed this beautiful

insect with its gauzy, iridescent wings and dreamy flight, its emerald green body, its jewel-like eyes; but if its charming colours have tempted them to capture and touch the insect they may have learnt a lesson. With all its delicate beauty this pretty fly is the veritable skunk amongst British insects. It can produce a smell so vile that if your fingers, and especially your gloves, should come in contact with it, you are assured of a most uncomfortable time, for the smell is often more than soap and water will remove. This foul odour is, doubtless, the insect's protection against its foes, but such delicacy of form and colour combined with so repulsive a characteristic is surely one of Nature's most incongruous performances.

JOHN J. WARD.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

THE APPLE AND PEAR GROUP—II

THE WILD SERVICE

THIS is a tree of very local occurrence, and chiefly in the southern counties. The grey bark is decidedly scaly. The buds are nearly round, shining, green in colour. There are narrow brown margins to the scales. The leaves are cut into from five to seven pointed divisions, each of which is supported by a strong secondary rib. The venation at the base recalls that of the Plane. The leaf margins have saw-like teeth. The flowers are more loosely branched than those of the White Beam. The fruit is oval, brown in colour, with lighter spottings.

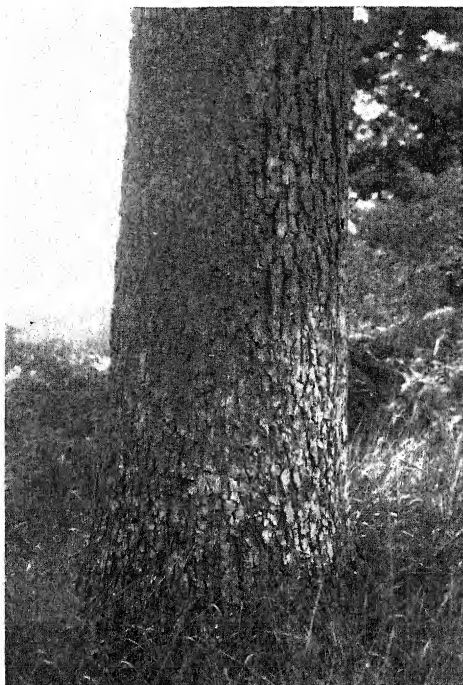
This is one of the earliest of our trees to assume its autumn tints, showing golden and brown shades among the green, often before the summer is gone.

A tree, usually distinguished as the True Service, is occasionally to be met with in park or garden. It bears less resemblance to the Wild Service than to the Rowan or Mountain Ash, for which it might easily be mistaken at first sight, having the same habit and similar foliage. A closer examination will at once reveal decided differences. The bark is like that of the Wild Service, rough and scaly from the first. The twigs are smooth and shiny, the buds are green, smooth, and slightly sticky. They stand out from the twig. The leaves, so like those of the Rowan, have broader leaflets, and these have marginal teeth near the tip only. The flowers, of a creamy white, are larger than those of the Hawthorn. The fruits, clustered two or more on a single main

stalk, may be round or pear-shaped. They are green, or reddish, with brown spots; are almost as large as crab-apples, and have a like depression at the base.

THE ROWAN, OR MOUNTAIN ASH

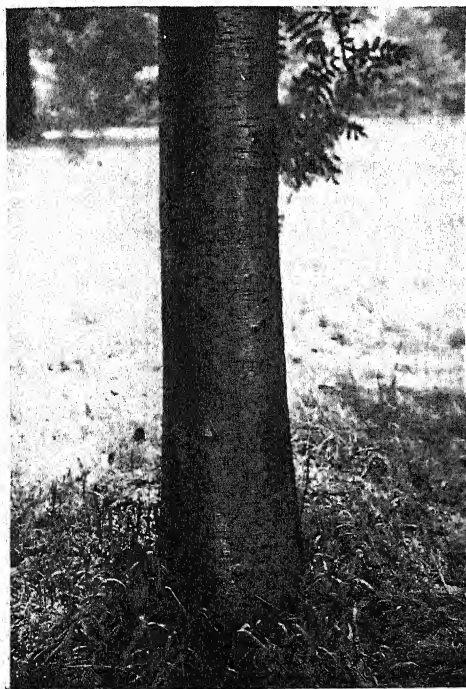
We have here one of the hardiest and most adaptable of our trees. Its natural preference is for the wild moorland, but it penetrates into the fastnesses of the mountains, and is found in Scotland at an elevation of 2,600 feet above sea level.



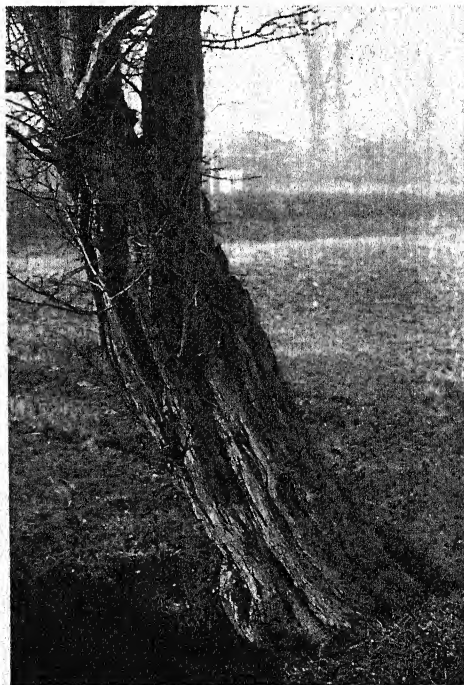
TRUNK AND BARK OF WILD SERVICE.

Yet it can fraternise with the Alder in the water meadows, and flourishes in thousands of suburban gardens. It is seen at its best, at all seasons, in the neighbourhood of the Pines, or upstanding with the Birches among the bracken and heather. It is never more than a small tree, and its branches ascend in rather loose order. The moderate quantity of feathery foliage carried by the branches give it an easy grace, an airy lightness.

The bark, which



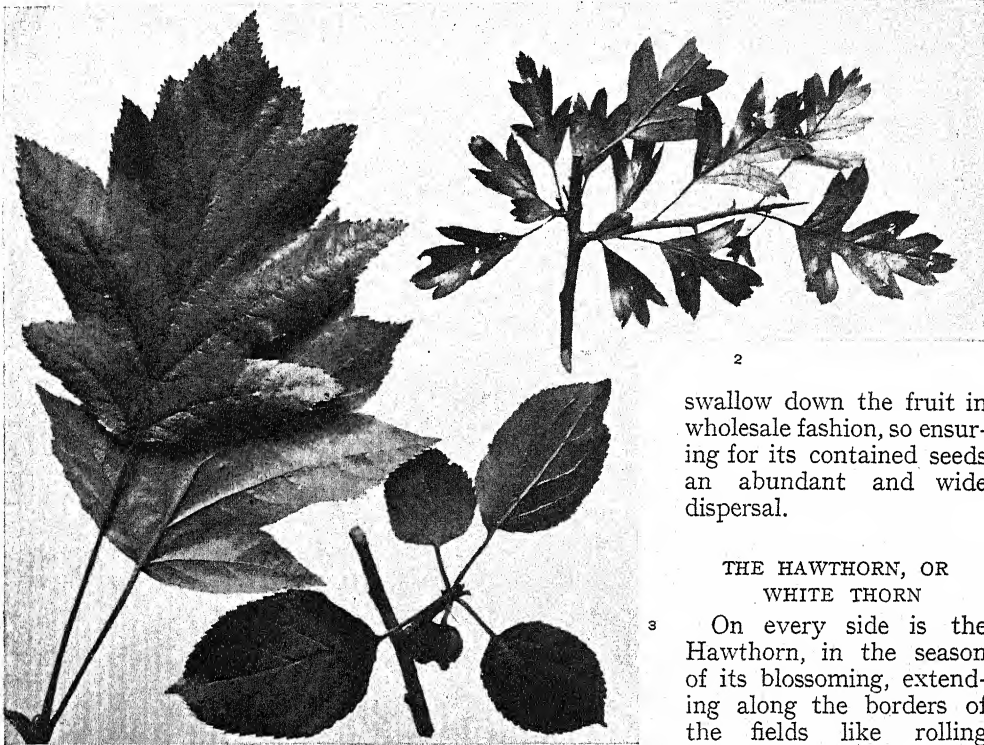
TRUNK AND BARK OF ROWAN.



TRUNK AND BARK OF HAWTHORN.

is grey in colour, is smooth at first, and marked with transverse lines as that of the Wild Cherry. Later it becomes thickened and furrowed. The twigs are short, slightly velvety, grey to brown. The buds are large, pointed,

indicated. The fruit clusters are brilliant with a colour all their own, a vermilion shade of red, which gives to this tree from late summer onwards, so long as the birds will permit, its most distinctive character. Blackbirds and thrushes



LEAVES OF (1) WILD SERVICE, (2) HAWTHORN, (3) WILD APPLE.

pressed up against the twig, distinctly velvety, purplish black or grey. Should doubt arise with respect to this tree, it may be distinguished from the Ash by the spiral arrangement of its buds. The leaf-scar is long and narrow, showing five leaf-traces.

The leaves are compound like those of the Ash. It is from this fact that this tree has acquired the somewhat misleading name of Mountain Ash. Rowan and Ash are not related. Each leaf consists of from five to nine pairs of leaflets, with a terminal one. The margins of these are toothed like a saw. The flowers are Hawthorn-like, but of smaller size individually, and borne as previously in-

swallow down the fruit in wholesale fashion, so ensuring for its contained seeds an abundant and wide dispersal.

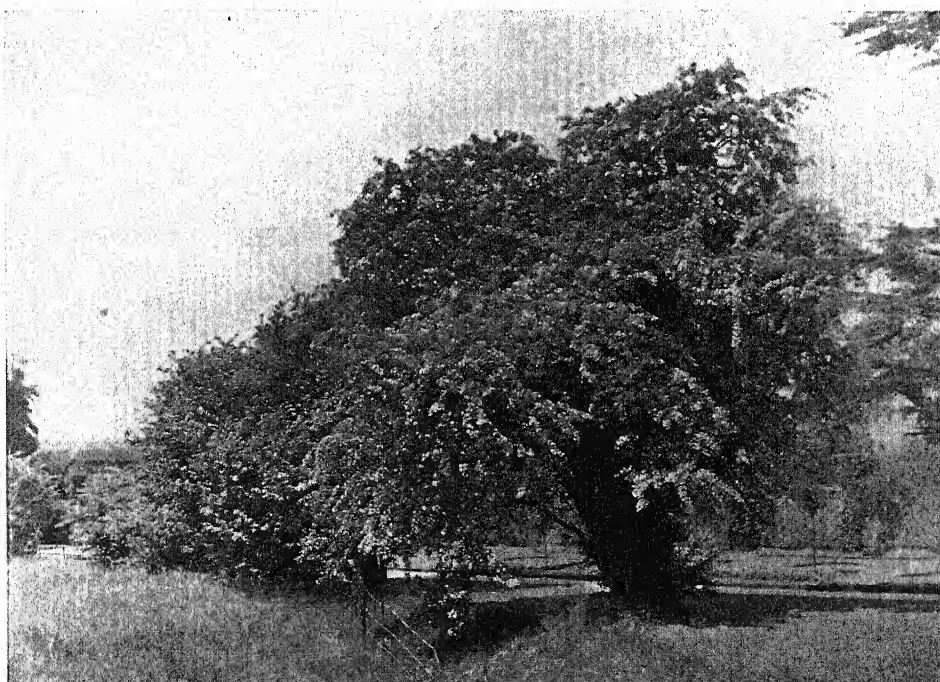
THE HAWTHORN, OR WHITE THORN

On every side is the Hawthorn, in the season of its blossoming, extending along the borders of the fields like rolling masses of sea-foam; scattered over the commons and up the hill slopes in mounds and wreaths; possessing all the land with the wonder, all the air with the fragrance, of the "May."

Growing as a small tree it presents a rounded crown, with great crowd and entanglement of branch and twig, which, through the summer, supports close density of shadowing foliage, beloved of many wild birds for the hiding of their nests. The dull grey bark of its often fluted main stem is roughened into closely set furrows. The twigs, which are dull brown, or silvery grey, vary from long shoots with buds and leaves apart, to short shoots with buds placed closely, and leaves gathered into tufts. These short shoots end in sharp thorns. Thorns are



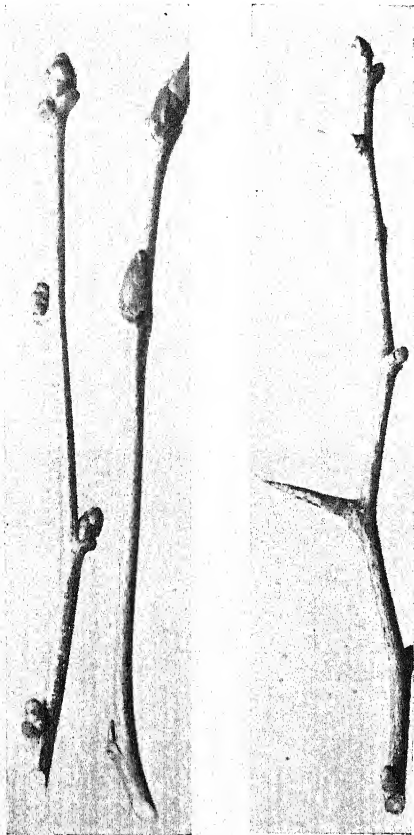
SCATTERED MASSES AND MOUNDS OF "MAY."



HAWTHORN IN BLOOM.

also found on the long shoots, rising out of these at the points of junction with the leaf-stalks.

The name Hawthorn, which is simply



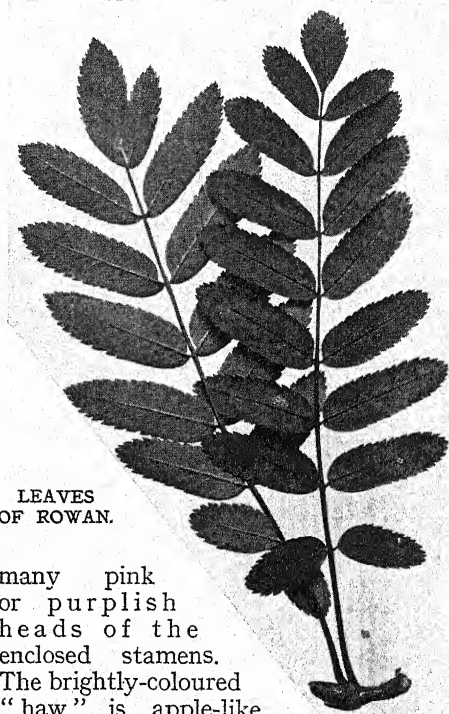
1 2 3
TWIGS OF (1) WILD SERVICE, (2) ROWAN,
(3) HAWTHORN.

Hedge-thorn, denotes the fact that this, of all growths, has come most into use in the formation of live fences. Easily propagated by cuttings, well enduring the shears, dense with crowded twigs and thorns, it speedily becomes an impenetrable barrier.

The leaves are extremely variable.

They show from three to five, or seven, main divisions, some of which are cut down nearly to the midrib. At the base of the leaf-stalks on the long shoots are leaf-like expansions (stipules), which here have the appearance and serve the purpose of supplementary foliage. In autumn the leaf colouring shows great variation and range—yellow, red, bronze, and purple.

The flowers are generally white, as those of the Blackthorn, but their whiteness is softened by the fresh greenery of the associated foliage, and by the



LEAVES
OF ROWAN.

many pink or purplish heads of the enclosed stamens. The brightly-coloured "haw" is apple-like in outward appearance, but it differs from the produce of other trees in this group, in that it is in reality a stone fruit.

HENRY IRVING.



CONCERNING THUNDERSTORMS—II

By WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.

ALTHOUGH I am interested both in ballooning and thunderstorms, I prefer not to study them simultaneously, and would advise others to do the same. Thunderstorms spoil all the pleasure and fascination of ballooning, because when one wishes to take an aerial trip the conditions are best when the wind is steady in one direction. This is not the case when a thunderstorm is in the neighbourhood. There is either no wind or it is liable to change its direction any moment, and flashes of lightning playing around are not desirable companions when one is supported by an envelope full of inflammable gas! Further, in the front of a thunderstorm there are up currents which are far from desirable when one is in such a craft, and it was my fate on the occasion of my first balloon trip to be in such a current. This occurred on June 29, 1907, when a passenger in one of the balloons competing in an Aero Club long distance race.

A violent thunderstorm was nearly over us as we ascended, and we expected to attain a certain altitude in accordance with our "lift." But this was by no means the case actually, for we found ourselves in a current directed from the earth, which not only sent us up an extra 2,000 feet, but was strong enough, before the balloon responded to the ascending current, to blow upwards into the basket of the balloon a large square of calico which was suspended from the side of the basket. At about 5,000 feet we somehow became free of this current, and naturally began to fall with considerable rapidity, which was only checked by the bountiful discharge of ballast.

Now perhaps the most important feature of a thunderstorm is the electrical phenomena connected with it, and naturally these are best seen when the storms occur after the sun has set. Lightning flashes

have been observed by man ever since he walked on the earth, but it was not till Franklin's time, in 1752, that we were taught that lightning was identical with the electricity that can be artificially produced. Franklin proved this by tapping the electricity under a thunder-cloud by means of a kite, using the cord of the kite as a conductor to bring the electricity to earth.

A lightning flash may be looked upon as the result of a great electrical disturbance between masses of vapour condensed in our atmosphere in the form of clouds, that part of the earth's surface which lies immediately below these masses, and the intervening air space.

Perhaps the most difficult question to answer is "How is the electricity produced?" Electricity is undoubtedly formed in our atmosphere, but whether it is the result of condensation of water vapour, or caused by evaporation, or by wind, or any other means, it is difficult to say. Its origin is generally attributed to condensation in the following manner. Electricity, it must be first understood, only resides on the surface of a body. Each minute particle of a cloud has a small electric charge distributed over its surface. When condensation takes place these particles coalesce and form raindrops. The surface of *one raindrop* being less than the combined surfaces of all those of the particles of which it now forms part, there must be more electricity per unit area on the raindrop than there was on each particle. The consequence is that the electrical potential of the raindrops increases with condensation.

The greater, therefore, the raindrops, the more heavily laden becomes the cloud and the darker it appears.

With this ever increasing store of electric energy on the cloud it is certain that a limit must soon be reached, and

an outlet must be found for it in some way or other. Now air, unlike copper or silver, or metals of any kind, is a very bad conductor of electricity, and since the cloud is surrounded on all sides by this medium, this electric energy finds no ready means of escape. Sometimes a heavy shower of rain is sufficient to carry off the electricity and reduce the potential of the cloud to that of the earth.

With very rapid accumulation of electricity, however, this safety valve may not be sufficiently quick acting. When this occurs the potential of the cloud may become greater than that of the earth below it or greater than that of a neighbouring cloud, with the result that a disruptive discharge through the intervening air takes place, and we have the phenomenon of a flash of lightning.

The discharge is called "disruptive" because the resistance of the air being so great, much of the electric energy of the flash is transformed into heat, and the air particles are put into such violent vibration that they become luminous.

Although the above reason has been given to explain the origin of the electrical condition in thunderstorms, the reader must still remember that no final decision has been arrived at. Whatever may be the source from which the electric discharge obtains its energy, there is no doubt about the enormous power pent up in such violent flashes. Thunder, the direct result of such discharges, makes one familiar with the forces at work.

So highly heated becomes the column of air through which the discharge makes its way that the air, in trying to accommodate itself to the rapid change of temperature, expands with all speed. This expansion and subsequent contraction—the air particles rushing in to fill the partial vacuum caused by the former—give rise to a series of air waves, producing sounds, throughout the entire length of the column. These waves are as much emitted by the main stream of the discharge as they are by the branches or ramifications of the flash, so that the sources of the different noises are at a great number of different distances from the observer. If the flash be a short one, and the observer near it, the sound will be almost simultaneous, and this is known

as a thunderclap. It is like a sharp rattling explosion, accompanied sometimes by a hissing noise. This hissing noise seems to be directly connected with the lightning flash, and is familiar to one who is acquainted with sparks made in the laboratory. It is therefore correctly referred to in the following quotation from the "Ingoldsby Legends":

"It was in such an hour as this
On such a wild and wintry night
The forked lightning seemed to hiss."

If, on the other hand, the flash is of considerable length and has many branches, the sound waves, emanating simultaneously from the various parts of the discharge, have distances of various lengths to travel, and so do not reach the ear at the same moment. The reason for this is that while light travels almost instantaneously, namely, 186,000 miles per second, sound only covers about 1,100 feet in the same time. The greater the distance the flash is away the longer is the time interval between the discharge and the hearing of the thunder.

The noise impressed on the ear by distant flashes is of a rolling or rumbling nature, and is usually referred to as a thunder-peal. Although the lengthening of the duration of a thunderclap may be to a great extent caused by echoes from the earth's surface, there seems reason to believe that a considerable portion of it may be due to the successive arrivals of the air waves from the various parts of the numerous branches of the main discharge.

It is sometimes stated that the rolling is due to the noises being reflected from the clouds, but in the face of the Rev. J. M. Bacon's experiments this cannot be claimed. Mr. Bacon made his experiments by exploding cartridges from underneath the car of his balloon, and although he always heard the echo from the earth, he recorded no instance when they were returned by clouds. His observations are so interesting that I quote one of them, which is of special importance here:

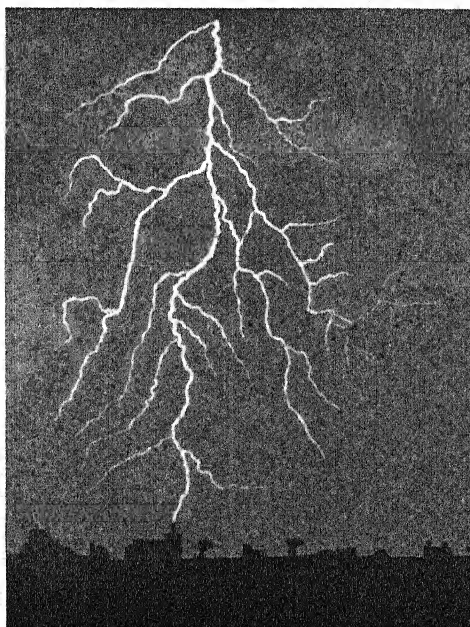
"First, when about 3,000 ft. above the cloud layer, we lowered a cartridge, and, stop watch in hand, listened carefully for the result. It exactly repeated our former experience. Absolute silence ensued, until

full time had elapsed for the earth to reply, when the same peal of thunder rose up which we were already accustomed to. And this thunder was in no way diminished by the intervening depth of dense cloud, which the waves of sound would have to traverse. . . . The result was always the same, and proved first throughout this afternoon there was never even the suspicion of an echo from the cloud or sky."

Leaving the subject of thunder, attention may now be directed to perhaps the most interesting feature of thunderstorms, namely, lightning discharges, which, as I have previously indicated, are nothing but ordinary electric sparks on a gigantic scale. Most of us are familiar with their general appearance. Their form was, and even now is, sometimes described as "zigzag," but this is quite erroneous, as many of my readers are aware. In a large experience of watching flashes closely, I have never observed a single instance of such a form, and after an examination of several hundred photographs I have never seen one that exhibited this shape.

Flashes of lightning, especially when they are accompanied by branches or ramifications, have very much the appearance of a river and its tributaries, as shown on maps. To illustrate what I mean I have prepared the accompanying illustration. Now this photograph is not a flash of lightning taken with a camera, but a composite picture made up dexterously by means of a piece of cut paper to represent a landscape, the use of cotton wool to give cloud effect, and last, but

not least, the tracing of the river Amazon and its tributaries from a school atlas, to represent the lightning flash! I leave it to the reader to decide whether or not the comparison is a good one, for actual photographs of lightning flashes are reproduced further on, and special attention is called to the flash on page 643.



Photograph by Dr. Lockyer.
A TRACING OF THE RIVER AMAZON AND ITS TRIBUTARIES TO REPRESENT A FLASH OF LIGHTNING WITH RAMIFICATIONS.

Curiously enough it is only, roughly speaking, within the last twenty-five or thirty years that the study of lightning has been made with the photographic camera. The application of the sensitive plate has, however, cleared up many old fallacies, while at the same time it has taught us many things concerning lightning flashes which were unknown before.

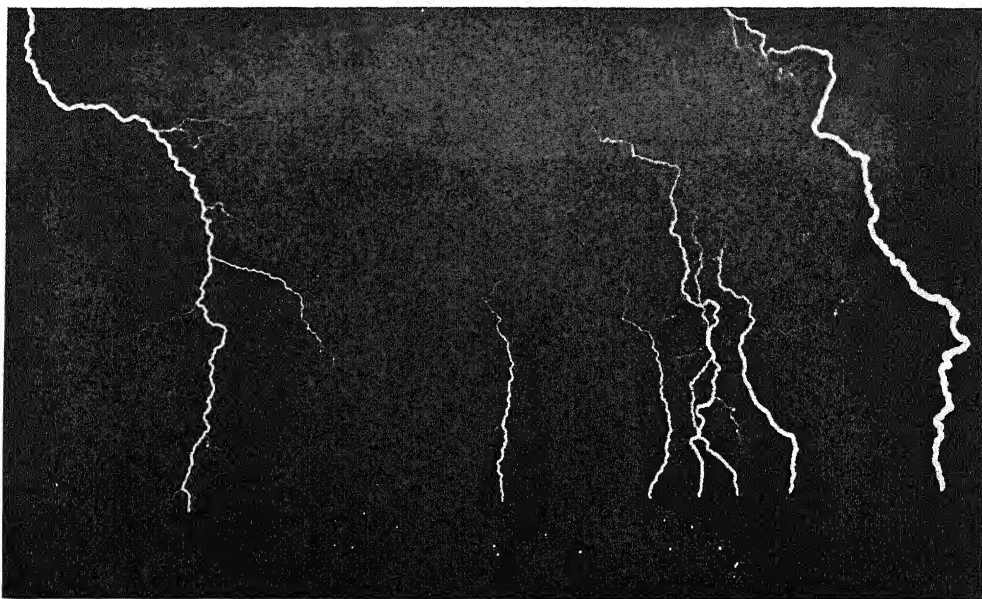
With such fleeting objects as these discharges the eye is very apt to be deceived, and it is just in such instances that the

camera becomes invaluable.

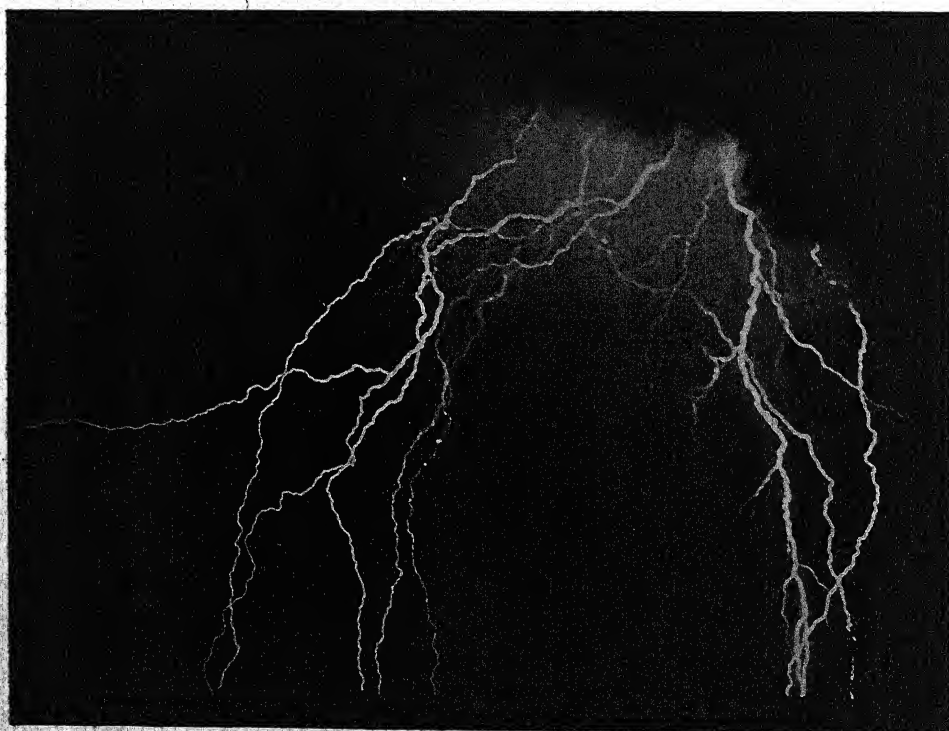
In fact, the enjoyment of a thunderstorm is considerably enhanced by making use of a camera, or several if one is fortunate to have more than one. One is able then to supplement camera with eye work, and obtain very useful results.

Space does not permit me to refer, even briefly, to the many points of interest that this instrument has opened up, but some of the more important of them may be mentioned.

In the first place, the general form of the lightning flash was accurately recorded, showing that the flash was usually of a wavy (not zigzag) nature, and that sometimes it had branches and sometimes none at all. Several specimens of these types will be seen in the accompanying



LIGHTNING FLASHES TAKEN IN AUGUST, 1892, AT SYDNEY, AUSTRALIA, BY THE LATE
MR. H. C. RUSSELL.



A SERIES OF LIGHTNING FLASHES PROCEEDING FROM A CLOUD TO THE EARTH
Illustrating the river-like form of the discharges and the continuity of the streaks representing several flashes.
Photographed at Vereeniging, Transvaal, by Mr. T. N. Leslie.

illustration. This beautiful photograph, showing a great number of brilliant flashes literally pouring down from one portion of a cloud, was taken at Vereeniging, in the Transvaal, by Mr. T. N. Leslie.

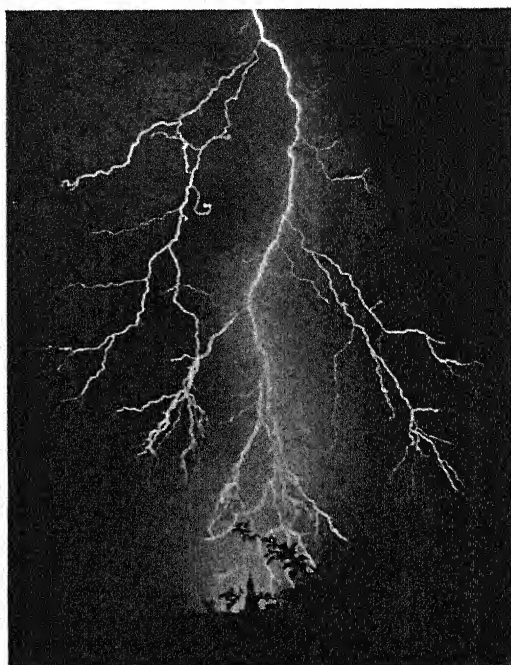
Another fine example illustrating several flashes scattered over a wider area is that shown on page 642. This photograph was taken during a storm which passed over Sydney Harbour, in Australia, in August, 1892. It was taken by the late Mr. H. C. Russell, and is one of many which he succeeded in securing.

It may be mentioned here that the branches in lightning flashes are, so to speak, leaks in the main stream; all the electricity is not able to pass quickly enough through the main channel, and so has to find other outlets along lines of least resistance. An approximate simile may be found in a leaky garden hose pipe when the tap is turned full on. The pressure is so great that the water cannot pass through the pipe sufficiently quick, so squirts out at those parts of the pipe where it can escape easiest. In the case of lightning discharges, even the branches divide and subdivide again, and the current in these cases becomes so dissipated that the earth is often never reached by any of them.

A good instance of this is seen in the photograph here reproduced, where the branches on both the right and left hand sides split up into several minor branches and vanish in the air. This interesting photograph was secured by Mr. Paul Georgi at Radebeul, near Dresden.

In all these photographs of lightning which show branches the flashes were discharges from cloud to earth. This direction of the electric current is established by noting the direction in which the branches leave the main stream. Thus, if the reader looks at the above picture, it will be seen that they point downwards, and thus indicate a downward discharge, or, in other words, a cloud-to-earth flash. The majority of flashes which have been photographed all indicate such downward discharges, but a few cases have been met with where the current flowed in the

opposite direction. Many observers of lightning have stated that they have seen such flashes, and were certain that the direction of the discharge was upwards; but their cases were generally looked upon as *non proven*, not only because no photographs displayed this peculiarity, but because it was considered impossible for



A RAMIFIED FLASH

Showing that some branches never reach the ground in consequence of the dissipation of the electricity. Taken at Radebeul, near Dresden, by Mr. Paul Georgi.

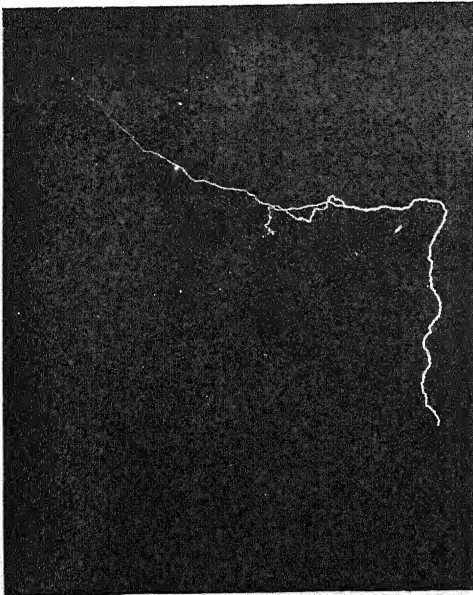
the eye to differentiate between an upward or downward discharge.

Tennyson was evidently conversant with the notion that lightning discharges sometimes were directed from the earth to the sky, for in *Becket* he wrote:

"Ah, Thomas,

That lightnings that we think are only Heaven's
Flash sometimes out of earth against the sky."

That earth-to-cloud flashes do occur is now, in my opinion, beyond doubt, and the best example which has been photographed is that which was secured by Monsieur G. Mesmer, at Paris, on July 31, 1904. This photograph is reproduced on page 644. Unfortunately the flash was not



Photograph by M. G. Mesmer.

A LIGHTNING FLASH FROM THE EIFFEL TOWER
TO A CLOUD, PARIS, JULY 31, 1904.

sufficiently brilliant to render the landscape very visible, so that it is impossible to make a reproduction which will show both flash and landscape at once. In order to indicate the landscape M. Mesmer took a photograph of it the next day, using the same camera and pointing it in the same direction. This photograph is placed beneath in the accompanying figure. The flash actually left the Eiffel Tower, and, it will be

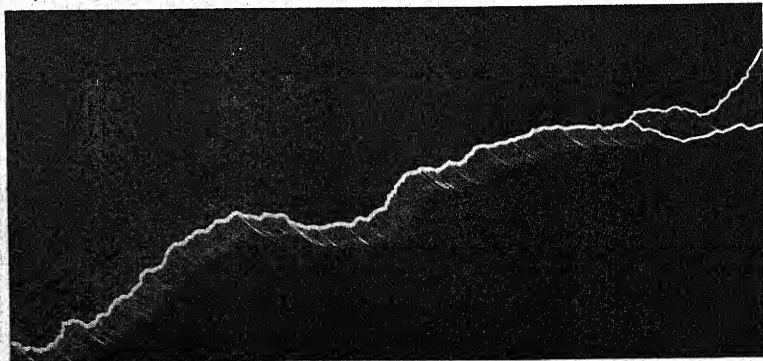
noticed, split up into two portions and disappeared in the cloud.

There are two other points of interest attached to lightning flashes which the application of the photographic method has cleared up completely.

Many good observers have published at different times accounts of lightning flashes which they described as "beaded," or "chapleted," or presented the appearance of a string of pearls. So well did all accounts agree with each other, that authorities were led to believe that a peculiar form of lightning flash was in question. There was, however, an element of disagreement between some of the descriptions, because one observer would state that he saw a flash which broke up into a series of points or beads, and another that he saw a series of beads alone.

Now the real origin of this "beaded" lightning, as it has been called, is this. We all now know that although a single flash of lightning is instantaneous, yet the discharge is so powerful that it heats up the channel of air through which it passes almost instantaneously to incandescence. Further, this column of air is not a straight vertical channel from the cloud to the earth, but very wavy, both in the line of sight of the observer and at right angles to it.

Now, when the lightning discharge is over, this air column cannot cool very quickly, and consequently it remains visible for several fractions of a second. Owing to the wavy nature of the column some portions of the channel will appear



Photograph by M. Emile Touchet.

TRAIL OF A LIGHTNING FLASH ON A PHOTOGRAPHIC PLATE DUE TO
THE INCANDESCENCE OF THE AIR.

Camera moved by hand. April 12, 1904, 9.40 p.m. Paris.

brighter than others, namely, those where the waviness is in the line of sight. In this way, what was in the first instance a single streak of lightning appears a fraction of a second later a string of luminous points.

The reader may question the statement as to the column of air remaining luminous, but this fact has been proved over and over again, and is very easy indeed to show. All one has to do is simply to point the camera in the direction in which it is considered a flash will appear, and keep on moving the camera to the right and left, pendulum fashion. As it is known that a flash is instantaneous the movement of the camera will have no effect on its image on the photographic plate. If, however, the air channel remains for a brief moment luminous, then it will not only leave a trail but the different portions of it will indicate various degrees of intensity.

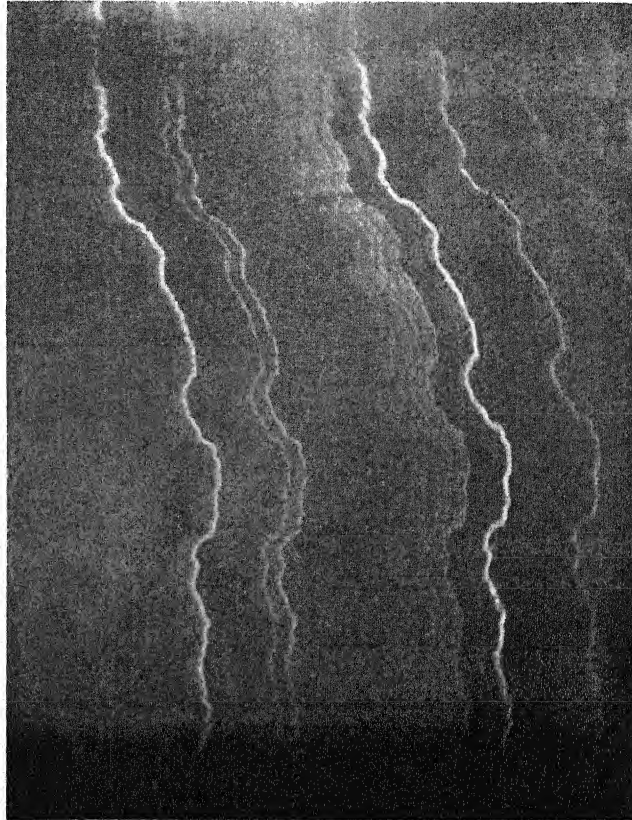
Such a method as has been above described was used to secure the photograph shown in the illustration on page 644, and it will be noticed that, not only is there a very distinct trail left by the incandescent air, but there are considerable differences of brightness at the more curvy parts of the flash. The photograph was taken by M. Emile Touchet, at Paris, on April 12, 1904.

The photographic plate used in this way thus tells us that "beaded" lightning is only an ordinary flash of lightning after all.

The next and last point to which attention may be called is an astonishing fact that the camera has revealed to us.

It has sometimes been remarked that lightning discharges were not instan-

taneous, or that they appeared to quiver, flicker, or vibrate, or that they appeared stationary or persisted for some seconds. Such observations, made by various observers living in different lands, evidently indicate that there *was* something peculiar about the discharges they saw,



Photograph by Alex. Larsen.
A MULTIPLE LIGHTNING FLASH.

Photographed with a revolving camera, showing the numerous components involved. Notice the parallelism of all the discharges.

otherwise they would not have drawn attention to them.

It has been already mentioned that a single flash of lightning is instantaneous, or, as has been stated by the best authorities, it occupies at the most $\frac{1}{100,000}$ of a second. Such a flash, if it did flicker, could not be seen to do so, as the interval of time is too short for such an observation to be made. Single flashes are therefore incapable of explaining the peculiarity noticed. What about double or triple

flashes following the same track? Would not these, with intervals of time amounting to, say, a tenth of a second between each flash, appear to flicker? Yes, certainly; but do such multiple flashes occur?

The astonishing fact which the moving camera has revealed to us is that single flashes are the exception in Nature, and multiple flashes the rule! Further, it seems that the faster the camera is moved and the more sensitive the plate employed, the greater is the number of component discharges that can be photographed, although they all appear to the eye as one flash. To show the manifold discharges which can be photographed in a flash which appeared as a single flash the illustration on page 645 is given. This most interesting photograph was secured by Mr. Alex. Larsen at Chicago, who mounted his camera on a whirling table. The main features to which attention should be drawn are the parallelism of all the flashes, showing that they all followed the same track; the different intensities between the individual discharges; and finally the great number of flashes involved.

After looking at such a photograph one can quite understand that a lightning flash can be seen to flicker if it is made up of many individual discharges

of different intensity, as the photograph indicates.

There are many other points of interest which both the eye and the camera have revealed that cannot be alluded to here. It is hoped, nevertheless, that sufficient has been stated to whet the appetite of the reader, and that he or she, as the case may be, will not in future look upon thunderstorms with the awe which has given rise to the saying: "When it thunders, the thief becomes honest."

When thunderstorms occur during the day-time the cloud and colour effects are the chief source of attraction, and the advent of colour photography will soon render it possible to record, in addition to the forms, the weird colours which are often seen on the approach of such storms. During the night the observer can revel in the delights of recording the many and interesting peculiarities of the brilliant flashes. A thunderstorm can thus be rendered a source of enjoyment whenever it occurs. Those fully prepared and armed with cameras can record the wild doings, as recommended in one of Tennyson's earlier poems:

" Then from a throne
Mounted in heaven will shoot into the dark
Arrows of lightning. I will stand and mark."
W. J. S. LOCKYER.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

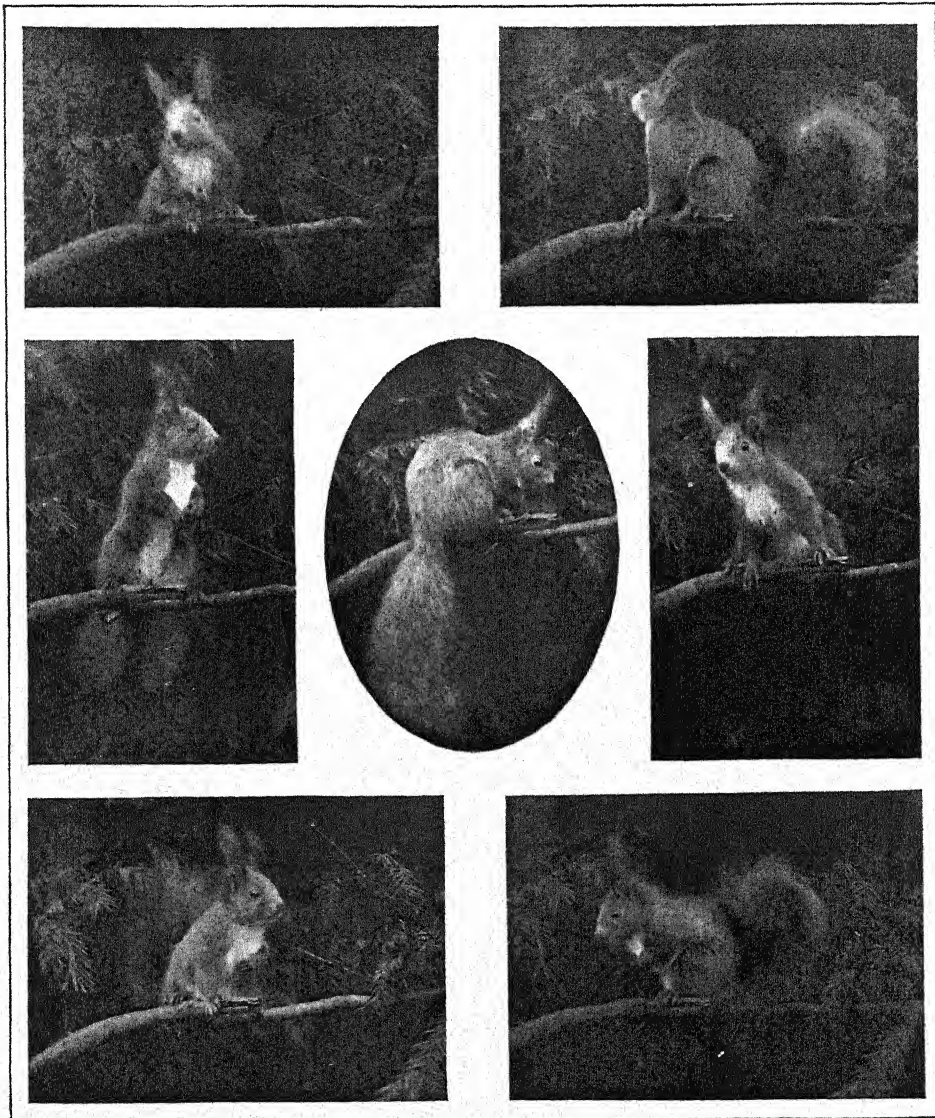
THE SQUIRREL

With Photographs by the Author

AGES ago, one may fancy, a certain woolly Marmot waxed fat and kicked. He developed, indeed, such petulance and devilry that he must needs climb a rock, and thence fling whistled insults at his companions. His descendants developed not only tempers but tails, and in due course became the race of Squirrels.

It is a race which is almost cosmopolitan in range (Australia and Madagascar alone are Squirrel-less), and which attains its highest distinction, so far as size and colour are concerned, in the Tropics.

Our own Red Squirrel, our "lytill squerell, full of besynese"—I am entertained to find that the latter quality has



SOME TYPICAL ATTITUDES OF SQUIRRELS.

been translated into American as "full of business" *—displays excellently the long sinuous brush, the wonderfully fashioned feet, and the abundant *vibrissæ*, or "sense-hairs," which characterise the group. His coloration varies much with

the "miniver" of the North European variety.

So far as I have been able to determine by inquiry, all true Squirrels are short-tempered. It is fortunate that Nature has limited their size, for, were the

dimensions of our British Squirrel twice as great as they are, this country could hardly hold him and man together.

His size being what it is (length all over about eighteen inches), and his fighting weight something under a pound, we can afford to view his outbursts with equanimity, and even derive some entertainment from the vehemence with which he rattles at humanity. His shoulders on these



A SQUIRREL IN SUMMER PELAGE.

The absence of ear-tufts and the coarseness of the fur should be noticed.

the time of year, tending to rufous in the summer and to grey-brown in the winter. The presence of long ear-tufts and of a full brown-yellow tail in the latter season adds considerably to his beauty, but he never, I think, in this country displays the extraordinarily rich orange tint which characterises his continental cousins. Indeed, compared with a stout Teuton Squirrel, our British representative appears somewhat patchy and washed out, and in winter the grey on him is not comparable in warmth of tone with

* Ingersoll's "Life of Mammals," p. 442.

occasions twitch with temper. He stamps with his fore feet, he stamps with his hind feet. His insult is a spitsome cough, his curse a chromatic howl. Both are unprintable, yet Millais makes a spirited effort at the latter. He calls it "Sk-wow-wow-wow!" "Kwitt, Kwitt" (in German) is the nearest approach to the former which I have read. The difficulty of transcribing non-human sounds is due to their deficiency in consonants. Yet ornithologists rush in boldly enough. To them "A - little - bit - of - bread - and - no - cheese" suggests the Yellowhammer.

It is fear of humanity alone which restrains the Squirrel from charging. If looks and ejaculations, let alone double-barrelled stamps, could kill, his morning round would be strewn with corpses. I say "morning" round advisedly, for the Squirrel breakfasts betimes, and it is the early risers who see most of him. More than once just before dawn I have seen Squirrels to all appearance sound asleep in the fork of a tree, or even some way out on a bough (they will weld themselves to a bough to avoid observation, but in this case their attitude is quite a different one). More than once I have visited captive squirrels in the darkness, and found them sleeping outside their nests in the most extraordinary positions. I have known them, for instance, to hang head downwards from a branch, and to sleep suspended by their hind feet or even by one hind foot alone.

A Squirrel's nest is, I fancy, in its origin a shelter against rain and wind. I have never seen Squirrels building at large, but I have watched them construct their nests in a spacious outdoor enclosure, and as the material provided for them was "natural," I think I am justified in supposing that I have witnessed their "natural" method.

To commence with, they collect a quantity of substantial twigs, carry them in their mouths to the site selected, and build them up, layer after layer, with a mixture of moss, leaves and so forth, until they have raised a pile about a foot high. They then twist this, with their hands and feet, and an occasional pull with their teeth, into a rough hollow cylinder, which they line with more moss and leaves, fashioning an inner sphere of the latter by rolling themselves round inside it. The roofing is accomplished from within, the twigs which form the sides of the nest being tugged into suitable positions. A bolt hole, sometimes two bolt holes are left, but these are not necessarily permanent, and it is considered by some observers that their outlook is determined by the prevailing wind. If this be the case the completed structure is wind-proof and water-proof, both of which conditions are essential to the comfort of the mature Squirrel, and to the life of the immature.

The breeding nest is usually about twenty feet above ground level, a depression in a hollowed fork, which is practically invisible from below, forming the most usual site. Frequently, however, a bird's nest is adapted, and Squirrels' nests have often been found at quite a low elevation.

I have mentioned that a Squirrel breakfasts betimes, but it is the exception rather than the rule that he should breakfast aloft. Even when, as is by no means always the case, he is feeding on arboreal products, he is as likely as not to come to earth with his meal in his mouth. Once he has secured his nut or fir-cone, or whatever it may be (it is a pretty sight to see him manoeuvre to get a big one, for he is as "nippy" as a tomtit, and can hang by a hair), he makes for the trunk and descends full tilt. Almost invariably he pauses before he reaches the ground and looks this way and that with his prize sticking out of his mouth. Then, if all be well, he drops to earth, and bounds off, his tail rippling behind him, to the particular spot which he has selected for a breakfast table. This, I have found, is most often a stump or fallen tree, on which he can sit a yard or so above ground level. Sometimes, however, he appears to trust solely to his hearing (no doubt he could thread the path to safety blind-fold), and feeds upon the ground. As might be expected in the case of an animal who is active, not to say impetuous, from year's end to year's end, the Squirrel has schooled himself to great variations of diet. His staple food is unquestionably vegetable, and his preference is for nuts and hard seeds. He can manage any British nut or fruit-stone (nuts he usually splits in half, but fruit-stones he has to gnaw), and he appears to possess an extraordinary nicety of perception as to whether the kernels are in good order. If you proffer a bad nut to a Squirrel, he will almost throw it at you.

Apart from nuts and fruit-stones, Squirrels are fond of all kinds of fruit containing sizable seeds—apples or pears for example, sloes, hips and haws, even corn. He is fond also of fungi, and the German naturalist Löns describes him as getting intoxicated on the fermenting sap of oak-bark. I have a note of a Squirrel busily engaged on the bark of an old

alder, whose abundant exudation of sap caused it to be a *rendezvous* for all kinds of insects. Before reading Löns' observation I had certainly imagined that this Squirrel was in quest of grubs and pupæ, of both of which he is mightily fond. Occasionally, as might be expected, Squirrels do considerable damage in plantations of seedling firs. So far as vertebrates are concerned, it is certain that the Squirrel will occasionally eat birds' eggs, and even nestling birds. I am strongly of opinion that this is a perversion of appetite, which occurs only in the case of a female Squirrel who is suckling her young. That a Squirrel's breeding season should correspond with that of many early nesting birds (young Squirrels have been frequently found early in March), and that the one time in the year in which she is most hardly pressed by hunger should be the one time when the supply of her natural foodstuffs almost entirely fails, is, of course, unfortunate for the birds; but who with a spark of humanity in him can blame the Mother Squirrel, let alone shoot her?

The best time for observing Squirrels at large is not only early in the morning, but early in the year. This is in part due to the absence of foliage, and in part to the fact that it is in quite the early months that the Squirrel's fancy turns (even more lightly, I fancy, than that of Pennyson's young man) in the proverbial direction. The Squirrel's courtship, more especially if it is complicated by the presence of one or more rivals, is worth rising betimes to witness, whatever be the season. It is the headlong, impetuous, utterly reckless affair which one would look for in a creature of the Squirrel's

temperament. The lady is fully as agile as her suitors, and the fact that the latter waste precious intervals in vainly buffeting each other, ensures a gymnastic display of a remarkable character. To begin

with, one is amazed at the precision and dexterity with which each movement of the pursued is mimicked by the pursuer. My Lady Shadow-tail gallops up the beech tree, loops twenty different branches, all but misses her footing, recovers somehow, darts outward along a tapering bough, ripples from twig to twig of it, and, when twigs fail her, leaps. The larch has beckoned to her. She lands upon an outstretched feathery arm, shoots off it like a rubber ball, lands once again, bounds upward to the trunk, slithers the length of this to earth, then flings about, and scales its farther side. So she speeds from tree to tree until you lose her. In hot pursuit comes Squirrel Number One. He runs the same bough outwards, stumbles at the same spot, leaps to the same landing, and even passes her, he downwards and she upwards, on the same larch trunk. Should fortune still befriend you, you may see Squirrel Number Two. Squirrel

Number One is quickly aware of him; he pauses a moment, half turns and chatters; so loses five yards from My Lady; then turns in earnest. Squirrel Number Two stops dead; both sit back on their haunches; both shrug their shoulders jerkily; both shake and stamp with rage. Presently Squirrel Number Two flings down his paws. *Thud, thud!* they strike the bough. *Thud, thud!* his hind feet echo them, each thud a half-inch progress. Squirrel Number One awaits him. He is still bunched and chattering, with his paws on guard. And now My



A



B

UNDER SURFACE OF (A) THE SQUIRREL'S HAND AND (B) THE SQUIRREL'S FOOT.

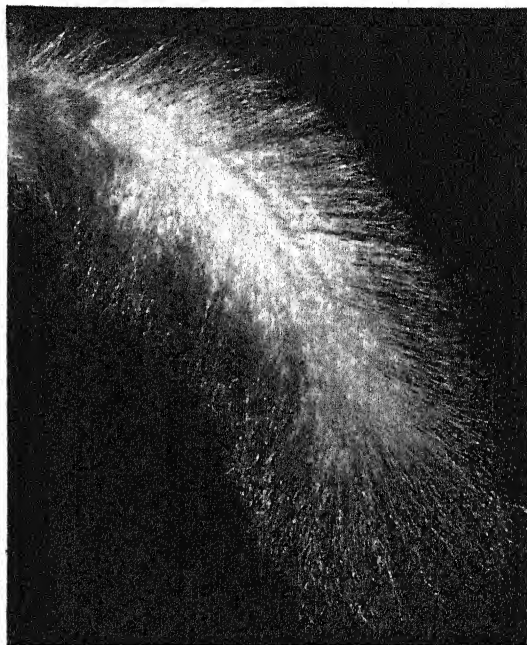
To show the difference in the development of the pads and the hair-coating.

Lady pauses. Down come Squirrel Number One's fore-paws. *Thud, thud!* upon the bough. *Thud, thud!* his hind feet echo them. Another moment and they are at grips. You see a whirl and gleam of tails (silver-grey in the sunshine); you see small branches flicker as they touch them; you see an inextricable confusion of tree and sky and Squirrels; you see that this confusion is falling; and presently you see that the combatants have parted, each to a separate bough, some twenty feet below their starting-place. How do they do it? How can two non-winged creatures fight on snapping twigs? How can one eye be kept on one's rival and the other on a landing-place, or even a second landing-place should the first one fail?

In his excellent book on the "Sense of Touch in Animals," Dr. Kidd has pointed out a peculiar feature in the papillary ridges of a Squirrel's hand. Dr. Kidd holds that arched, whorled, or looped papillary ridges (such as occur on human finger-tips) are specialised types, and that longitudinal, oblique, or transverse ridges are primitive types. He holds, further, that the chief use of both types is in connection with the sense of touch, and that their frictional use is subsidiary. Other investigators, notably Miss Whipple, hold that the chief use of papillary ridges is frictional—they serve, that is, to "rough" the hands and feet.

One would certainly expect to find that a Squirrel's hands were specialised to avoid side-slip, and that they would also give some external indication of hypersensitiveness of touch. So far, however, as the papillary ridges are concerned, they appear to have no obvious specialisation. The ridges are few in number and indefinite in form, the most noticeable being those on the palms of the hand, which radiate forward from the proximal portion of each pad. This arrangement is unusual, and by no means self-explanatory. The pads, as can be seen from the illustration on page 650, take up such a large proportion of the palmar

surface that its grasping area is practically hairless. The soles of a Squirrel's feet, however, in which the pads have oblique ridges, and are much smaller in proportion, are fairly well haired. These facts suggest to me that in the case of a Squirrel leaping from one slippery bough to another, the take off is strengthened by the hairy, non-



UNDER SURFACE OF SQUIRREL'S TAIL.
Showing the "banding" of the long hairs.

slipping character of the soles of his feet, while the landing is broken by the elastic buffer character of the palms of his hands.

For a "tactile sense of the position of his body in space," the Squirrel must, I think, depend on his *vibrissæ*—it is unfortunate that we have no English word to correspond with the German *Sinneshaar* (sense-hair), for the structure of *vibrissæ* is quite different from that of ordinary hair.

The *vibrissæ* of the Squirrel, in addition to being abundant on the muzzle, appear over and behind each eye, and, farther back still, beneath the throat. The latter position is by no means a common one. He also has a growth of them in the neighbourhood of his elbow joints (the reader will remember something similar in the

case of the Stoat), and generally the portion of him forward of the shoulder girdle may be said to bristle with "receivers."

Though it is probable that a Squirrel's tail may, on occasion, serve as a parachute (it is decidedly distichous), I am inclined to think, from observation of a number of Squirrels, that this particular function is seldom in evidence, and that the main uses of a Squirrel's tail are the nice adjustment of his centre of gravity, and the provision of a warm winter wrapping. So far as the former is concerned, a Squirrel who is sitting back on his haunches (his normal feeding position), or who is sitting still on a branch,

(see illustration on p. 648), arranges his tail S-wise, so that the main weight of it is disposed over his back. When leaping from bough to bough, or over the ground, a Squirrel's tail may be fully extended, or arched, either disposition being completely under the control of the Squirrel. When sleeping in his nest, a Squirrel, like a Stoat, wraps his tail round himself, and includes its mouth in its shelter. It serves, in fact, as a respirator and blanket combined. I am not satisfied that Squirrels ever become torpid, even in the hardest weather, or that they ever make a store. "*Improbis atque improvidis*" would be a fitting motto for the clan.

DOUGLAS ENGLISH.

ANIMAL EPICURES

By GERVAISE TURNBULL

IT is a curious and interesting study to notice the very various tastes and antipathies which animals in a state of domestication show in the selection of their food supply. Depraved tastes may occur in some cases where, as in cats and dogs, close contact with civilisation has blunted the natural instincts; but with the ordinary farm animals there is a natural selection shown, generally of a healthy character, when they are allowed to roam at liberty.

It is a wide one, too, and more discerning than might be supposed from first observation, and horses, cattle, sheep and goats, and even pigs, show their likes and dislikes in an unmistakable manner. Horses, we all know, are most particular in the foods which they will eat when in the stable, and if they show less discernment when grazing they have their fancies, though probably not to the same extent as sheep. Their chief characteristic when grazing is the way in which they pare the grass closely down in certain places, leaving a patchy appearance in the field. This points to a difference in the taste of

the herbage, which, though apparently the same to the observer, horses are not slow to find out. Indeed, it is noticeable that a preference live stock generally show to one field over another, due largely, no doubt, to one being of better quality than the other, but also, perhaps, because some particular kind of herbage or plant is there which they affect.

It may, perhaps, surprise the general reader to learn that a very large number of plants may be growing in a grass field that appears to the casual observer to be "nothing but grass." The subject was carefully gone into some years ago at Rothamsted, the great scientific station for agriculture, and on the plots there grown as many as eighty-nine kinds of plants were found. Only twenty of these were grasses, and ten leguminous plants, so that there were a large number of weeds, as they would be called in arable ground, though no doubt many of them would be appreciated by live stock.

It will be interesting to trace the particular plants that grow in this way, and also in hedgerows and similar places,

that are singled out by different kinds of live stock when they are browsing at liberty. We all know that horses are partial to the leaves and bark of trees, owing possibly to the tannin which they contain. This substance, in moderation, is considered by some to be of use as a tonic. Some leaves, such as the oak, contain rather a lot of tannin, and would hardly be so valuable for fodder as those which contain less. The idea of making use of leaves for fodder may seem a strange one, but the foreigners have for some years been ahead of us in this respect, and in France vine leaves are largely used.

Osier leaves, willow and lime are supposed to be useful in England, as well as those of the oak, birch, beech and poplar. A year or two ago some interest was aroused in the subject, for a herd of cattle was enabled to live on a leaf diet through a burning drought where they would otherwise have starved—for cattle like leaves as well as horses. They are aromatic, like the spices which are relished in patent stock food, and here, doubtless, lies their attraction, added to a pleasing sense of a change of diet, which all animals so much appreciate, especially if it is stolen!

Horses have also dislikes peculiar to themselves, and this is seen in the case of the sow thistle, a very common weed, rich and free growing, which is a favourite food with many animals—notably pigs and rabbits—but is refused by horses. Possibly it is too bitter, but this hardly seems likely, seeing that this is the case with so many edible plants. Gorse is a plant which horses appreciate when ground up—it seems to be used more in Ireland than in England. It is doubtful, however, if they would do more than eat the young shoots if the plant were not first prepared in a gorse-mill which turns the prickly stems into excellent provender, reputed to give a good sleek coat, and to be of use also in a medicinal way. There are many plants that seem to act in this manner, with sheep especially, and likely enough when not feeling quite fit, animals pick out certain plants which do them good, just as cats and dogs eat grass.

Sheep eat young gorse shoots also, but

their natural diet is rather different from that of horses or cattle, and it is well known that both sheep and goats, especially the latter, have a wide range of taste, and eat some plants which cattle will not touch.

For instance, they eat agrimony (*Agrimonia Eupatoria*) but most cattle refuse it, and they will sometimes eat the young shoots of heather, but no cattle seem to care for the fine-leaved heath, or Scotch heather (*Erica cinerea*), a very similar plant to the common heather or ling upon which the grouse thrives.

Sheep eat most of the plants which are attractive to cattle, but they seem to dislike some of these; cow-wheat (*Melampyrum pratense*), for instance, is rejected by them. This seems strange, as the plant is considered to be a valuable food for cows, and Linnæus said that when cows are fed in fields where this plant is abundant the butter they yield is peculiarly rich and brilliantly yellow. According to Dr. Prior the curious name comes from the fact that "its seed resembles wheat, but is only fit for cows." There seems to have been an old idea amongst country people that the little seeds of the plant could be turned into wheat as they fell.

Amongst those plants in pastures which sheep eat but which cattle reject are ragwort, knapweed, and ox-eye daisy, an uninviting trio, certainly, and it is not surprising that cattle should consider such dry, harsh food as beneath their notice. Wild wallflower seems unpalatable enough, but sheep will eat it, and it is said to be quite wholesome, and, moreover, very useful against certain diseases,—an instance of a medicinal herb again—and in days gone by it seems to have been actually sown for sheep-feeding, along with sheep's parsley, another herb with a good deal of flavour.

Sheep are fonder of such pungent plants than are other live stock, but it seems to be a mistaken notion that wild thyme (*Thymus serpyllum*) forms a valuable part of the herbage on upland pastures to which sheep are partial. It was supposed to improve the quality of the mutton fed upon it, but probably, like many other curious legends which have grown round some of our wild plants, there is no truth in the notion.

Common tormentil is another little plant with more claim to attention, because it is said that besides being nutritious as a herb it has the singular and very useful property of keeping at bay that great scourge on damp pastures—foot-rot; for where tormentil is grown this tiresome and painful complaint seems not to exist, but this is one of those old-fashioned remedies so seldom seen in practice that we may doubt whether it is even known to many farmers.

There are a number of wild vetches, and as many as ten species are reputed to be of use as pasturage for cattle, though they are not cultivated. In olden times more seems to have been thought of them than is now the case, for an old worthy, Dr. Plot, says in his "Natural History of Stafford" that tufted vetch (*Vicia cracca*) and wood vetch (*V. sylvatica*) are able to "advance starven or weak cattle above everything yet known." This sounds curious in these days of cattle foods, but no doubt some of these plants are distinctly valuable, and all cattle seem to like the bush vetch (*V. sepium*), extolled by Gerarde, which grows early and late. *Lathyrus sylvestris* is another handsome and very valuable wild plant, the narrow-leaved everlasting pea, or Wagner's pea, a plant with infinitely more nutriment in it than most of those mentioned already, yet cattle do not take to it very readily.

The likings of some live stock are very curious, and seemingly irrational as regards the buttercup tribe, for if we may believe one authority the field crowfoot is

greedily eaten by cattle, but is fatal to dogs and sheep, which are not easily poisoned. All the crowfoots are acrid, and, as a rule, are disliked by cattle; indeed, cases of poisoning have been traced to their consumption of them. The water buttercup (*Ranunculus aquatica*) also is said to be liked by cattle and even to be nourishing, but cattle are not fond of the ordinary buttercups in the meadows, and as far as they can they do not eat the flower stalks and heads, though it must be difficult for them to avoid eating the leaves. The notion that buttercups give a rich golden colour to butter seems therefore to be quite a mistaken one, but it was a very common notion at one time, and "John Buttercup" was a familiar name for a dairyman.

Some plants have very curious attributes, and *Polygonum aviculare* is one of these. It is the common knot grass, and is one of the least attractive and luxuriant of plants, yet in olden times it seems to have been much thought of and valued as a "suet producer." Milton and other writers have insisted on the partiality which cattle and sheep show towards it, but this seems rather doubtful, as it is so much in evidence as a weed in some fields.

Some weed plants, such as the sorrels, are held in estimation by all kinds of live stock, and in the same way a few, such as the spurge laurel, are universally disliked; but goats will eat deadly nightshade, henbane, and other poisonous plants!

GERVAISE TURNBULL.



HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE SWIMMERS—I

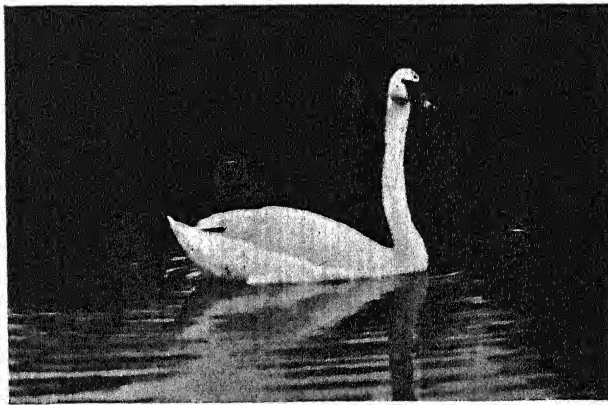
THE Moorhen and Coot, last referred to, form the connecting links between the Waders and Swimmers.

Foremost among the swimmers are the Geese—large birds, with oval-shaped bodies, long necks, and short, stout beaks, tipped with a distinct nail, the varying colour of which in the different species is, in some cases, an aid to identification. The strong beak, high at the base and rapidly falling away to the flattened-out extremity, is well adapted for cropping vegetation. The wings are long and powerful, and the legs, placed well under the centre of the body, afford ease in walking. All the Geese are gregarious, visiting us only in winter, and then chiefly seen—except by those who follow them for sport—whilst flying high up in the air from one feeding-ground to another. They proceed either in V-shaped formation or in an irregular line in which each individual keeps at an even distance from its neighbour. The leader drops to the rear when tired with the extra exertion of cleaving the air for its followers.

On the wing, Geese are unmistakably larger than Ducks, and may be distinguished at a distance from the larger Gulls by their more rapid and heavier flight, long, outstretched necks, shorter tails, and larger bodies in proportion to the wing-spread. They may be divided into Black and Grey Geese. The former are practically sea-birds, whilst the latter procure their food—grass and the blades of young corn—from the marshes and uplands.

All species are shy and wary, and seldom feed without leaving a sentinel on guard.

Although the Black Geese, Brent and Bernacle, are probably only likely to come under the notice of many of my readers when hanging up on the poulterer's stall, yet a few remarks upon them may perhaps prove acceptable. The Brent is the commoner of the two Black Geese,



Photograph by P. Webster, Newcastle-on-Tyne.

HOOPER SWAN.

and it is also the smallest British Goose—only about 21 inches in length; the Bernacle is some 4 inches longer. At first sight the Brent appears to be quite black, but at close quarters adult birds show an irregular white neck-ring, and have a white patch under the tail. The Bernacle chiefly occurs on the west, whilst the Brent prefers the east side of our coast; has head, neck, and throat black, with white cheeks. The back is lavender-grey barred with black and white, and the under parts are grey and white. The legs and feet are black in both species.

Of the Grey Geese, the White-fronted

is least likely to be confounded with any other species; it is the most slender in shape, and has a conspicuous white forehead, whilst the breast is irregularly blotched with black. The hoarse and oft-repeated "ha-ha" note has given this species the name of the "Laughing Goose." In length it is about 27 inches; but measurements alone cannot be depended upon for identification purposes, as they differ according to sex and age in

The Grey-lag sometimes has a little white at the base of its beak and some black feathers on the breast, but its flesh-coloured legs and larger size will distinguish it from the yellow-legged and less heavily built White-fronted species.

Two kinds of Wild Swan visit us in hard weather—the Hooper and Bewick. Both may be known from the Mute Swan, not only from the beak being lemon rather than orange yellow, but also



Photograph by P. Webster, Newcastle-on-Tyne.

MUTE SWAN ON NEST.

most birds, and according to race with some—the more northern forms being generally the smaller.

Grey-lag, Bean, and Pink-footed Geese much resemble one another. The first-named was once a resident in the eastern counties, but now only breeds sparingly in the north. It is the largest British Goose, measuring nearly 3 ft., though the Bean is only an inch or so shorter, and the Pink-footed is about 28 inches. The Grey-lag has flesh-coloured feet and beak, white nail, and grey rump and wing coverts. The Bean has yellow legs, brown beak with black nail, with sometimes a little yellow showing on the centre of the beak. The Pink-footed is somewhat similar, but its legs and the centre of its beak are flesh-coloured and the nail is black.

from the fact that the tip of the beak is black and the base yellow, instead of *vice versa*, as is the case with the tame species. On the water they both—and the Hooper especially—carry their necks more erect, with the beak at right angles to the neck—not depressed as is usually the case with the Mute species. The Bewick Swans are more Goose-like and sociable, and keep closer together than the Hooper whilst feeding. The heads and necks of both species are often stained to an orange yellow from the colour of the water in which they feed. Their measurements are respectively 5 ft. and 3 ft. 9 in. The young of each are dark grey in the first season, and light grey in the second.

The small price which these birds fetch in the market should tempt any naturalist

to purchase one, if only for the purpose of examining the double-keeled breastbone, between the two walls of which the elongated windpipe passes and returns ere it enters the lungs. It is supposed

that this is a provision of Nature to enable the bird to feed in icy cold water—the frigid air being therein warmed on its passage to the lungs.

MAURICE C. H. BIRD.

THE SEDGES—I

By MAUD U. CLARKE

With Photographs by HENRY IRVING

THE tribe of the Sedges (*Cyperaceæ*) resemble the Rushes in some respects, but more often the Grasses, both in the leaf arrangement and also in the construction of the flowering schemes. For the most part, however, the leaves are stouter and stiffer, with the leaf-sheath wrapping entirely round the stem and unsplit. The flowers are often rudimentary, contained in green or brown spikes, solitary or terminal; the capsule being one-celled holding one nut-like seed. It is a very large family and possesses most variable characteristics, spreading over the world in all moist situations. It forms an intermediate class between the Grasses and Rushes, distinguished from the former through the absence of the secondary or inner protective scale—the palea—that surrounds the flower of the Grasses; and separate from the Rushes as possessing no regular perianth or flower. The glumes of the Sedges are mostly brown, or greenish-brown. The *Carex* stand out amongst them as a specialised type, well-defined and apart, on account of certain botanical distinctions which I will not particularise other than to mention the three-angled stem devoid of joints or solid nodes. The Greek term *Keiro*, I cut, gives the family name to this species, in respect of the sharp edges of the leaves, which character seems further expressed by the bayonet shape of the stem.

The leaves are noticeably sharp in the case of *Carex vulpina*, the Great or Fox

Sedge, one commonly met with in wet ground. The height is variably from two to four feet, half a dozen grassy leaves springing from the stem at the lower six inches of its growth, the remainder shooting upwards bearing the green or pale-brown spike at the top. The length of the spike itself is also variable, from one to three inches.

The bracts associated with the flowering glumes are widely spread and bristly; the whole spike when in the seeded state being stiff and harsh with the beaked glumes and pointed bracts.

The surface of the angled stem is grooved, shining, and of a very beautiful green colour. The flowering continues through June and July, and by August the stiffened heads show the beaked fruit encased within the bracts. Sometimes one comes upon this Sedge tufting up under shelter of the gorse on commons where there are water-holes below, making beautiful curved lines of bright green against the sombre spinous growth. In such places the gold flowers of the Lesser Spearwort often glitter in quantity, the plant we recognise as a buttercup in the flower, yet differing from it in growth and leaf-structure. Quite likely the Water Crowfoot, too, may be there, spreading a patch of its green linear leaves over the ground, with a white flower or two still showing though the pool has become grass-grown.

It is certainly a rather confusing matter, when one's knowledge of plants is a little

limited, to attempt dealing with the items of a conglomerate of species growing on any yard or two of damp ground on our commons or waste lands. There are plants that look like something we know, only there is a perplexing variation that convinces one it is certainly not that plant but another. One stumbles upon the illimitable power of variation, the expression of Nature's wonderful flexibility; it is there for us to learn of, or let alone according to our bent. In just such a water-hole, or in its immediate neighbourhood, we may also find *Carex leporina*. It is a far more slender species, with long, thin stem of the same three-angled form, sometimes rising as high as four feet when pushing through the undergrowth, or may be only twelve inches, as circumstance allows. The grassy leaves are much narrower than those of *C. vulpina*, tapering into almost thread-like form at the extremity. The outer scales at the base of the spikelets also terminate in fine hairs longer than the scale itself. The flowering

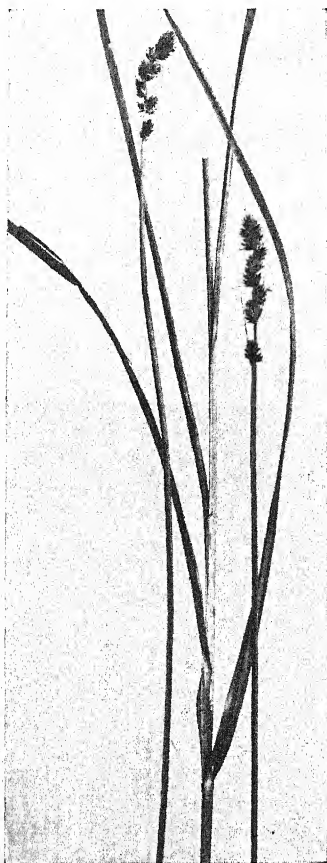
head is usually composed of five or six spikelets placed in close succession round the axis of the stem; on close examination they show very fine hairs bending from the point of the glumes. These hairs, in the early flowering stage, give a very soft effect to the whole mass.

Provided the damp situation is given, we can find these Sedges in very many different combinations of circumstances and surroundings, especially in such quarters as those of a boggy common. I have found them piercing through the bramble vines, with the little Marsh

Speedwell spreading below, or springing up above water grasses such as the Floating Fox-tail and Flote Grass; or growing clear out in the open, surrounded by the Carnation Grass, stiffly erect, curl-

ing its grey-green leaves like ornamental iron-work. This latter plant is also a Sedge, by the way — *Carex panicea*. Enthusiasts never tire, as a rule; and if plants happen to be the objects for the enthusiasm, the eyes of the enthusiasts are always ranging the ground for possible discoveries of that sort. In this way little *Carex flava* may be happened on, even if only showing its minimum presentation of three inches, when it is an inconspicuous greenish plant rising from green grass.

There is no mistaking the Sedge character when once known, with its spikelets set upon the flower stem rising vertically from a tuft of grassy leaves. The height may be as much as eighteen inches, the plant being easily recognised by the yellowish-green colour of both leaves and spikelets. The fruit is beaked, and set outwards from the

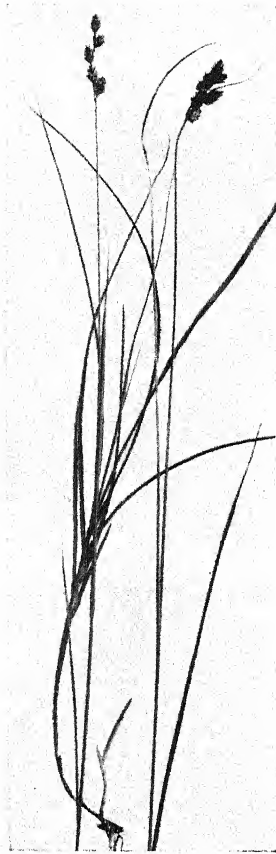


GREAT OR FOX SEDGE.

axis of the spikelet, sheathed with bristly bracts.

In the illustration (p. 659) the two top-most spikelets are shown in the dried-off stage, when the soft mass of closed bracts becomes a silvery fawn colour. They are the staminate spikelets holding the staminate flowers; the lower ones of the stems are always the pistillate, or fruiting spikelets, either stalked in some species, or set close to the stem.

In *Carex Goodenovi*, the Common Tufted Sedge, we see the pistillate spikelets set closely together with the staminate one at a distance; whereas in *Carex remota*,



CAREX LEPORINA.

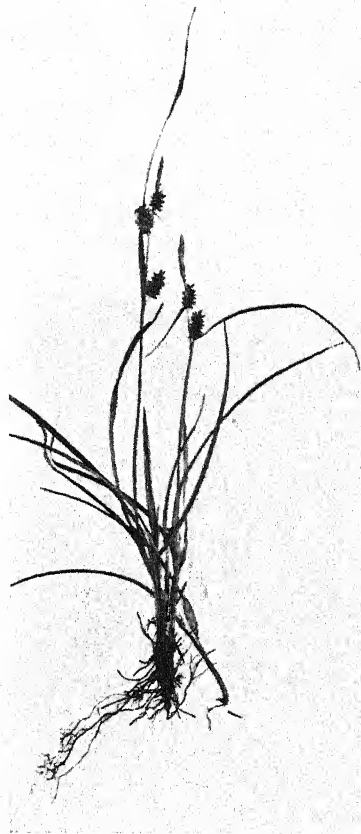
British Sedges of the *Carex* family, each adopting its own particular mode of growth, or specialisation. Of the two last-named species, the latter, a slender type of Sedge, likes damp copses or places where there is some sort of shelter; whereas the former, with a stout three-angled stem, finds its home in wet fields or marshes in the open.

There is much diversity in the relative position of the spikelets with regard to each other, and in the length or shortness of their stalks—*Carex glauca* having in the lowest pistillate spikelets five curving stalks of perhaps two inches long; *C. muricata*, or Great Prickly Sedge, having the very small spikelets

the Distant-spiked Sedge, the reverse plan becomes the habit of the plant. There are over seventy varieties of

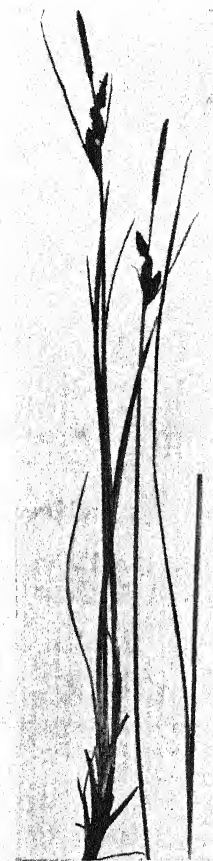
quite stalkless and set in the leaf-angles of the stem. Its growth is slender, with narrow leaves and a rough three-angled stem, and it is found in a tufted fashion on dry pastures. Of the stouter species, when the stems run to four and five feet high, making great masses of growth as much, perhaps, as four feet across, one might name *Carex paniculata*, the Great

Panicked Sedge; *Carex acutiformis*, the Pond Sedge; and *Carex riparia*, the Greater Pond Sedge, and largest British species, with as many as twelve large spikelets—a ditch plant and quite common.

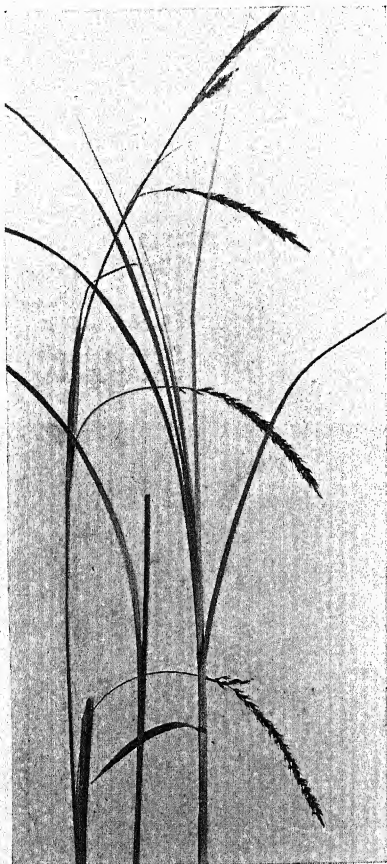


CAREX FLAVA.

The Wood Sedges are mostly familiar to us—both *Carex sylvatica* and *Carex pendula*; although, perhaps, *Carex depauperata*, or Starved Wood Sedge, is not so commonly met with. As the name

COMMON TUFTED
SEDEGE.

suggests, the habitat is a starved soil in dry woods; and although the plant grows two feet in height, it has a slender, feeble character, the spikelets

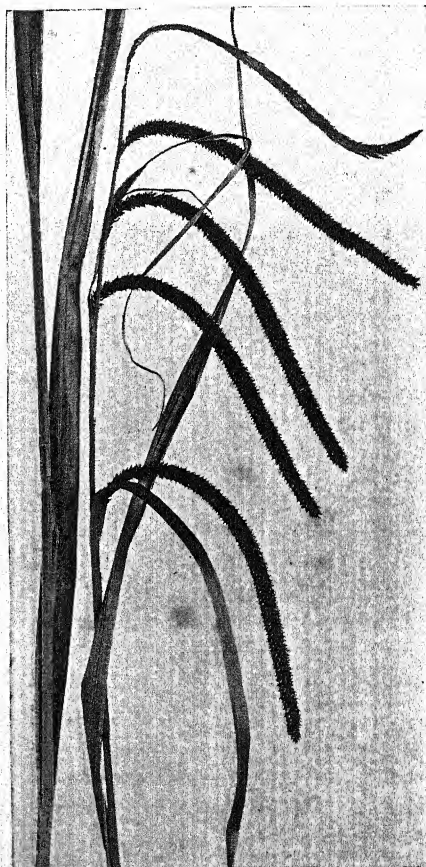


CAREX SYLVATICA.

being very abbreviated and the fruits few.

Carex sylvatica, on the contrary, has long fruiting spikelets from one to three inches, curving downwards on slender stalks. In damp woods it may grow three feet high, making strong tufted growth. The Great Drooping Sedge (*C. pendula*) is a very imposing species that sometimes runs up six feet, hanging out long, closely-set spikelets, with the stalks hidden in the sheaths. The leaves are

lengthy, quite half an inch broad, making great masses in the wet hollows. Such places are generally marked with a vivid green, all growth suggesting the luxuriant cell-formation of the water-loving plants. I have seen the seedling growth of *Prunella vulgaris* spreading like Duckweed on the firmer yet saturated ground, with the inevitable Soft Rush tufting up beside the black rotting *débris* of the woods—broken bark and larch cones spotted with fungi, and all

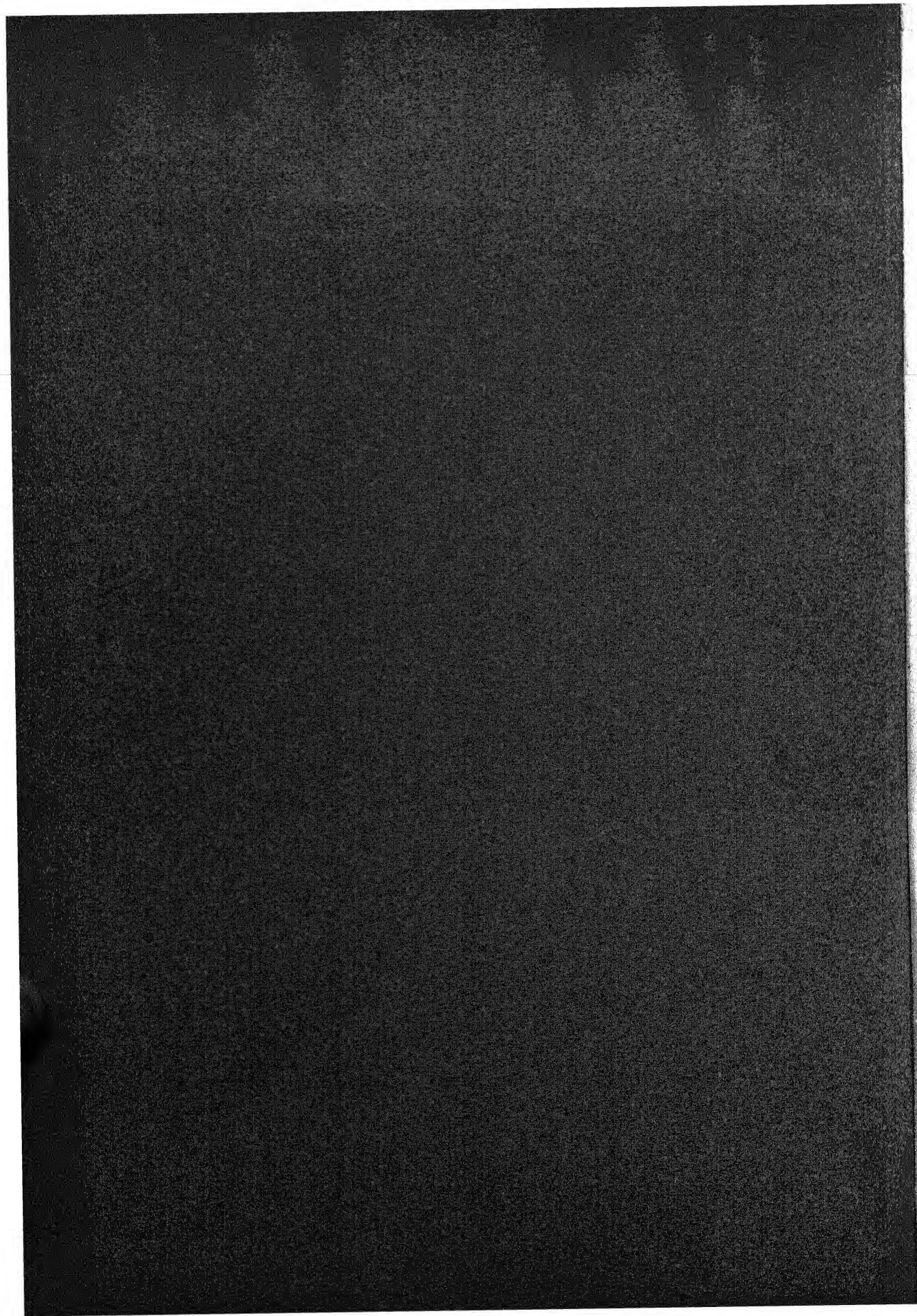


GREAT DROOPING SEDGE.

manner of plant structure in fractional condition passing through the chemical transformations that eventually extinguish their recognition.

MAUD U. CLARKE.

THE CHECK POINTS OF THE ROAD
AND THE WATERSHED DIVISION OF THE ROAD





AN IRIS GARDEN NEAR CAMBRIDGE.

Photograph by F. Mason Wood, Winchfield.

THE WILD GARDEN

By H. H. THOMAS

IT is a strange though common fallacy to assume that the wild garden is necessarily a garden run wild, for this assumption reveals only half a truth. There must be order in the wild garden. Even Nature is methodical in her direction of the ways of plants and flowers. First, and perhaps most important of all, there must be some method in the selection of the plants; and their arrangement is a matter of scarcely less moment. One must have plants whose beauty is found chiefly in their vigour and virility, and those whose charm lies largely in their trailty. One kind must not override the other, or there will be chaos where there

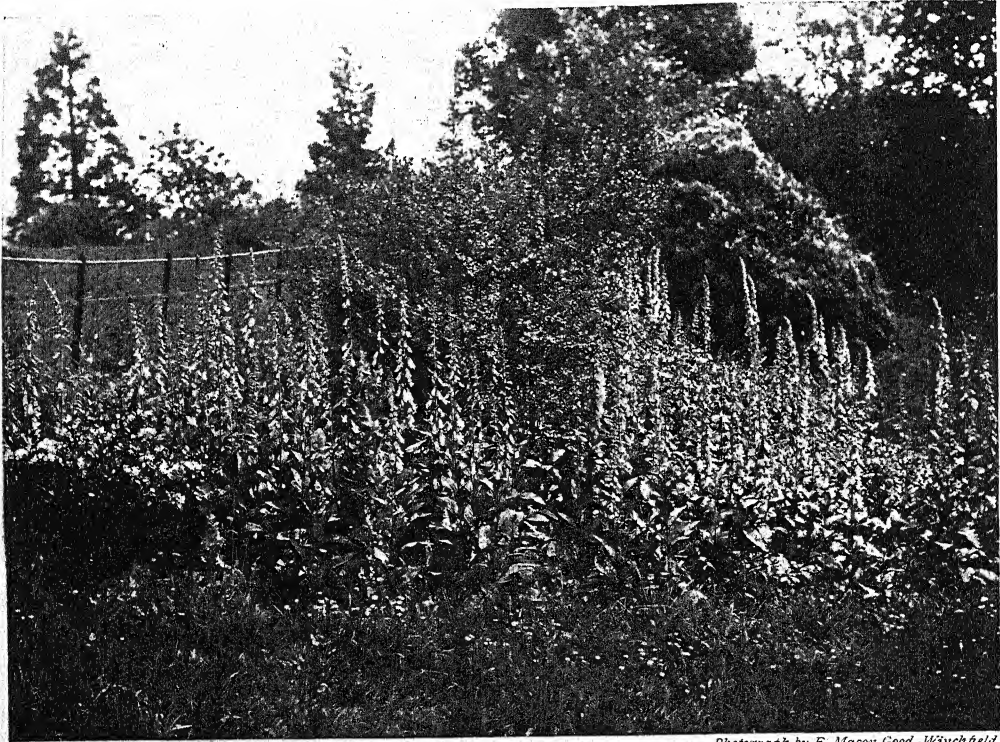
should be natural order: and the chaotic wild garden is no garden at all; it is simply a collection of plants run wild. The most successful wild garden is made on the woodland fringe where there is an open space among the trees. There must be luxuriant beauty everywhere, grace of leaf and charm of blossom. The happiest wild garden is found where there is perfect commingling of foliage and flower.

One season is scarcely more fascinating than another in the wild garden that fulfils its destiny under skilful guidance. In the depths of winter, when snow lies heavy on evergreen boughs and frosted twigs scintillate in the winter sunshine,

when Snowdrops and Crocuses, Aconite and Lenten Rose, make fairy carpets of blossom in sheltered nooks, and the Winter Sweet and Jasmine, Daphne and Witch Hazel, strike a note of refreshing colour among shrubs for the most part bare of leaf and blossom—even then there is beauty and to spare in the wild garden.

their leaves, the branchlets give their blossom, and the ground marshals in ever-increasing array its pageant of gaudy bloom. Daffodils and Bluebells, Squills and Windflowers, Violets and Primroses, join the swelling throng.

In summer time the glades are aglow with Roses—Dog Roses, Japanese Roses,



Photograph by F. Mason Good, Winchfield.

COLONY OF FOXGLOVES IN THE GARDEN, FORD ABBEY, CHARD, SOMERSET.

As "winter dies at the soft sweet breath of spring," the woodland trees, grim in their stately solitude, lose their individuality, merge their austerity in perfect association with the garden growing up around them. The bursting buds show green against the brown, so tempering the aspect of the giant boughs that soon their frown becomes a smile. And, answering to the silent call, the hard ground softens, the dank earth dries, the shrubs take on their tenderest tones, and the flowers of spring break quickly into blossom. Then—as gradually a verdant canopy and deepening shade envelop wood and garden—below, the twigs yield up

Musk Rose, and Sweetbriar; the air is redolent with the fragrant breath of Honeysuckle, of Lilac, and ablaze with the bloom of Azalea and Rhododendron. Where the shade is dense, Ferns cover the ground with a canopy of fairest green, while here and there Foxgloves in white and rosy purple, Bellflowers in blue, and sometimes a lowly carpet of white Woodruff, throw welcome colour on the leafy screen.

When

"There's a tinge of grey in the land of bloom,
And the song of the birds is hushed,"

the wild garden has still an exquisite



Photograph by E. Mason Good, Winthrop, Me.

A WOODLAND WALK.

charm. The dying glory of its autumn leaves, the golden glow of Coneflowers and Sunflowers (which—strange anomaly!—are not unhappy in the shade), Aconites and Japanese Anemones, Starworts and Moon Daisies: these and more invest it with

a house. "Men come to build stately sooner than to garden finely." The digging and delving and subsequent planting had been a long labour of love. The soil was light and sandy, so there was no need to gravel the paths; these were dry



THE WILD GARDEN, WISLEY.

Photograph by F. Mason Good, Winchfield.

a charm that casts a magic glamour. The successful wild garden is full of hidden beauty. The walks wind with seductive curves, exposing here and hiding there, now overgrown by untrammelled Rose, now with fragrant fringe of flowering bush. Grassy ways with moss-grown banks lead on to richer beauties, themselves, well clothed with seedling fern and self-sown flower, compelling admiration.

The most delightful wild garden I ever knew was fashioned out of a small woodland where the dusky tops of giant Scots Firs towered high above the rugged boles, casting a gloom in winter, a sombreness even in summer. The garden had grown gradually, as all true gardens must. One cannot make a garden as one would build

even in the depths of winter. There were surprises at every turn. Now and again each path would open upon a little green, safely hidden by Bamboos, by Rhododendron and other close-growing shrubs. Winter Aconites and hardy Cyclamen, Snowdrops and Crocuses, dappled the mossy grass with early colour, while round about the shrubbery fringe were little colonies of Daffodils, Snowflakes, Japanese Primroses, and other flowers in which the wild garden delights. But the fern dells were its beauty spots; these had been dug out some five feet deep, and the excavated soil formed high banks on either side of the narrow path. These were masses of pleasant leaf and occasional flower, formed chiefly of ferns, London

Pride, Ivy-leaved Toadflax, St. John's Wort, Periwinkle, Bellflower and Foxglove. The paths leading to these leafy dells were cunningly contrived, and, like some merry child at play, would wend hither and thither, and at the moment least expected discover to you the goal. Vigorous creepers climbed high up some tree-trunks, chief among them being Dutchman's Pipe, clambering Roses, ornamental Vines, the large-leaved Irish Ivy, Virginian Creeper, Polygonum or Bindweed, and Old Man's Beard or Traveller's Joy. Most of these veiled rather than hid the giant boles, scarcely detracting from their innate charm while investing them with a fresh strange beauty.

Then in high summer-time the glory of this little wild garden lay in its clumps of orange and scarlet Lilies, Madonna Lilies, Azaleas, Mock Orange and Giant Spiræa; and round about the little pond there clustered golden Marsh Marigolds, Siberian Iris, Lady's Smock, Flag Iris, Japanese Iris, Reeds, Rushes and Sedges. And casual sunbeams filtering through the Fir-tree tops, touched to brighter lustre the moisture-loving flowers, and brought an unwonted radiance to the water surface.

But after all there is no wild garden comparable with that fashioned by Nature with her own wild flowers. Take note of common effects on the woodland fringe, the roadside ditch, the hidden hollow, and see with what simple material Nature achieves her most gorgeous effects. Flowers are not found in twos and threes

dotted here and dotted there, but in bold and striking groups, in soft and graceful masses. First of all choosing the spot that grows them best, Nature poses them in great sheets of leaf and flower so skilfully that while they combine to form one harmonious whole, each is complete and satisfying in itself. The most fascinating wild-flower scene I have ever come across was found in a meadow in South Bucks. From end to end, from side to side, bounded only by the limiting hedges, the meadow grass was covered so thickly as from a short distance to appear hidden by the Purple Orchis, a great and wonderful mass of colour such as the wild flowers of this country seldom deign to show. Another scene that haunts the memory and brings home to one the wondrous beauty of even the prosaic highway is that of a small pond, its stagnant surface smothered beneath white, yellow-centred blooms of the Water Crowfoot.

He who would plant a wild garden should carry such scenes as these in his mind's eye. They will influence his work, and perchance when the garden has grown it may be found that the fascinating spell which memory weaves has imparted to the artificial garden something of the naturalness of the wayside and the wilds, a naturalness that admits of no explanation yet carries with it the glamour that distinguishes a garden from a mere collection of plants.

H. H. THOMAS.



THE SEDGES—II

By MAUD U. CLARKE

With Photographs by HENRY IRVING

THE Common Cotton Grass (*Eriophorum angustifolium*) to ordinary observation certainly appears a flowering grass, with the scheme carried even further towards the realm of flowering plants than in others. Yet the characteristics upon examination place it distinctly as of the tribe of the Sedges and apart from the Grasses. In the first place there is the solid versus the hollow stem; and although the umbellate cluster of cottony tufts, so like an elaborated mass of stamens, is suggestive of the flowering plant, yet are they widely different in actual construction and purpose. For in the Sedges the perianth, or collective scheme of corolla and calyx, is either absent or merely represented by scales or bristles. The white tufts of the Cotton Grass are a mass of these bristles extended, sometimes as much as two inches in length, and of beautifully silky texture, for this species has perfect flowers though of minute proportion. Some of the spikelets are fixed on the stem, others project further out on long smooth stalks, the whole group, varying in number from three or four to twelve, emerging from a large membranous bract expressed at the top of

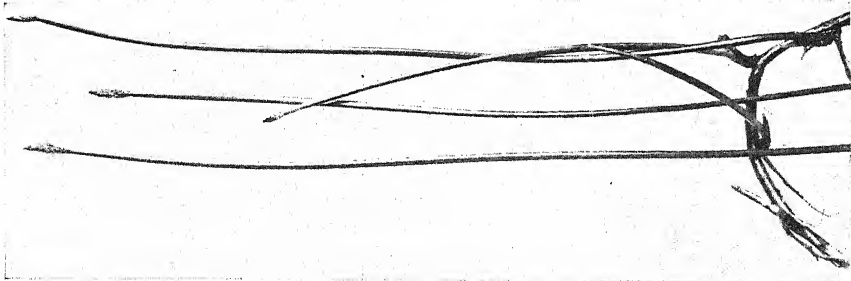
the stem. The leaves are sharply channelled at the base, the under side being "keeled" in character, as shown in the base of the broad blade to the left-hand side of the illustration. In the blade springing from this one and arching to the right, we see another characteristic of the Sedges in the way it is folded flatly together longitudinally. This species is a tufted perennial plant of one foot

in height, with erect flowering stems rising from the mass of grass leaves. It flowers early in the year through May and June, and although described as common, I have not found it growing in many apparently appropriate places. As my personal acquaintance with the plant is confined to the Long Valley, Aldershot, I should feel inclined to regard it as being local rather than common.

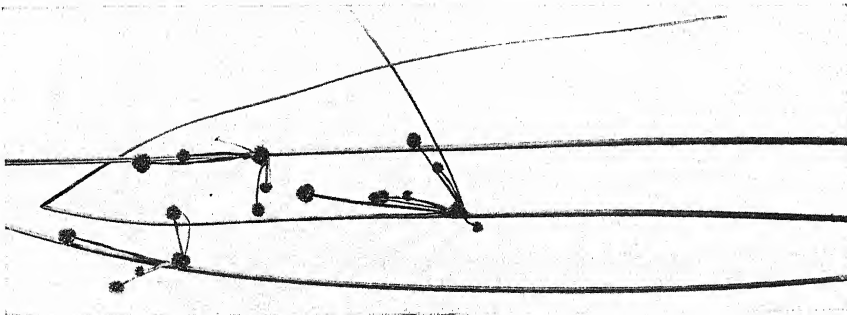
In the wet hollows of our woods, *Scirpus sylvestris*, or Wood Club Rush, spreads its shining channelled leaves in thick patches, the stout stem of two or three feet bearing the umbellate panicle of spikelets during July and August. It possesses a perianth of six bristles, very different in character from those of the Cotton Grass, for the small dark green spikelets only show the little



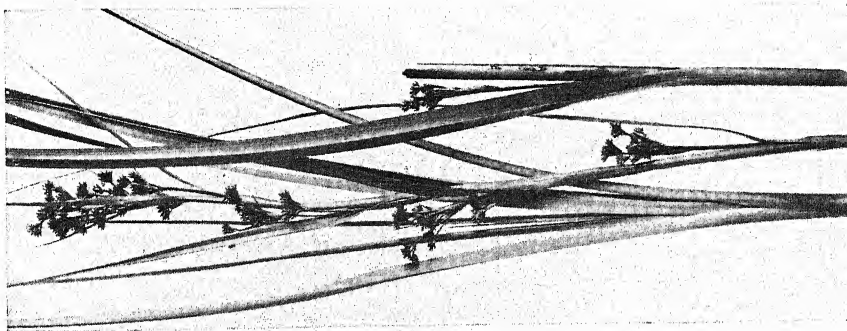
COMMON COTTON GRASS.



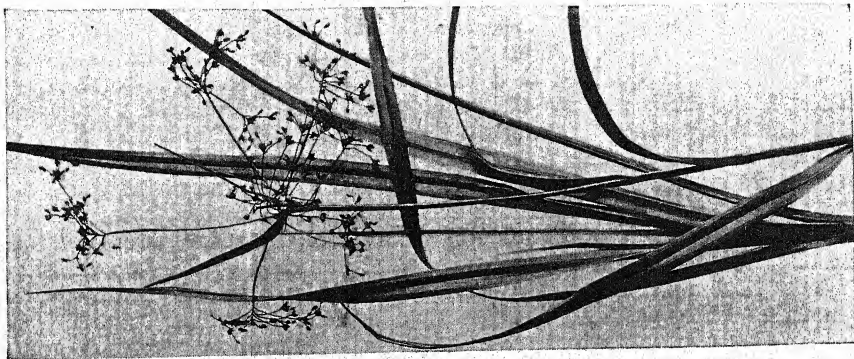
MARSH SPIKE RUSH.



MUD RUSH.



TWIG RUSH, OR PRICKLY CLADIUM.



WOOD CLUB RUSH.

point tipping the glumes that gives a slightly softened appearance to the group; the interior bristles are invisible. The umbel is complex in the variable length of the stalks of the panicle, and again in that of the individual spikelets. There is, further, a fringing of leafy bracts that spring from the axis of the umbel in addition to the leafy extension of the flower stem itself. In true Sedge fashion the blades fold flatly together in the early stage of growth, giving a generally flattened formation to the whole tuft of blades grouped together in something of a fan shape. The further expansion spreads them broadly open, when they curve freely outwards from the flower stem; the deep groove or channel, however, never becomes obliterated.

This character is repeated in the Twig Rush, or Prickly Cladium (*Cladium mariscus*). Here we have one of the isolate species as far as Britain represents the class. Approaching near the Beak Sedges, it is distinguished from them in habit, although coming nearer in some of the exotic varieties.

One of the distinguishing characters is the thick texture of the fruit. The nut-like seed tapers at the top, the outer coating being dense and fleshy until dry, when it becomes brittle. It is a bog or marsh plant of most temperate regions, with a representative in some tropical parts. In Britain it is scattered, not perhaps commonly, over England and Ireland, but is quite local in Scotland. I have met with it in Wiltshire, growing in the run of a very old mill-stream, where the water entered a meadow through an underground channel which cut a deep ditch and collected the mud about the roots of the water-plants. The Bur Reed flourished there also, and many square yards of the Soft Rush spread into the grass—a haunt of the moorhens and yellow wagtail. This Cladium is a tall rush-like plant, with strong, creeping rootstock and leafy stems varying from three to six feet high. The leaves are erect, or nearly so, the lower ones nearly as long as the stem, which they sheath at the base, becoming afterwards sharply keeled and terminating in a long, narrow point. The keel and edges are very sharply cutting, being bordered by minute teeth. The collective panicle of spikelets

is long in shape, sometimes twelve inches; the individual clusters are small but numerous, of pale-brown colour, set in the axils of the upper leaves. The group of glumes contains usually one perfect flower in the innermost glume, an incomplete one in the next, whilst the four or five outer ones are empty and shorter in formation, the stamens being two in number. The plant flowers late in the summer.

Our next illustration certainly inclines one to regard it as a Rush rather than a Sedge. Nevertheless the Mud Rush (*Scirpus holoschænus*) is a true Sedge by reason of many distinct characteristics, notably the nut-like seeds enclosed in the mass of glumes that form the brown globular heads, and held as lateral umbels on the stem.

In this species, as in some others, the outer bract of the umbel is prolonged as a stiffened extension that tapers to a fine point. The secondary bracts are variable both in length and strength. In the upper portion of the right-hand specimen we see how the bract has rolled inwards at the edges, producing the stiffened strength of an almost cylindric form. The four-foot stems are so throughout, with one or two stiff leaves only, wrapping the extreme base. As the name suggests, it is a mud-loving plant—the tidal mud of our southern and western shores, where sand mingles with it. There are other varieties, including the *Scirpus fluitans*, or Floating Mud Rush, a slender-jointed plant; *S. cernuus*, the Bog variety, a much slighter plant of only ten inches in height, and the Bristle-like Mud Rush, *S. setaceus*, that is smaller still, sometimes less than six inches. All of them are perennial in habit, but *S. holoschænus* flowers later than the others—during September and October.

The Marsh Spike Rush is strongly individual in expression, and possesses four differing methods according to circumstances. The tribe *Eleocharis*, of which *E. palustris* is the representative selected, are named from the Greek terms *helos*, a marsh, and *chairo*, I rejoice. This Marsh Spike Rush rejoices in its habitat as a creeping plant, with strong rhizome that branches, sending up the slim stems with their terminal flower spikes high above the water line.

This is the all-important determination,

for the plant is content with six inches of growth on the wet margins of pools, whereas it will strive to attain double that height and more when the pool surrounds it. There is a certain resemblance to the Plantain flowers in the dark brown collection of glumes, flecked in colour with their pale papery edges and green keels. The length of the head is not usually more than half an inch, the perianth having four or six bristles, with the flowers perfect. Circular at the base, the stems have a tendency to flatten above into angles; they are enclosed in sheaths that terminate squarely where the stem escapes, as seen in those of the illustration, attached to the rhizome. These sheaths are again protected at their junction with the root by a membranous bract-like structure that is evolved from the outer skin of the root itself.

When growing in-shore the leaves are of a tufting habit, as are the flowering stems; but if the plant is surrounded by water, and the additional height is necessitated, the stems become more solitary, as if the formative instinct resorted to economical measures. Since the effort to maintain safety for the flowers had extra calls made upon it, the reserve force of the plant was restricted in the multiplication of stems. There is something limited in the appearance of this plant; it scarcely appeals to us as others of the Sedges do, nor does it suggest that it has attraction for the insect tribe.

We have now come to the last of the Sedges selected, and one that takes us at once in mind towards the Rush tribe in much of its exterior formation—*Scirpus lacustris*, or what was once called the

Common Bulrush. Nowadays most people associate that name with the Reed Mace, the club-headed *Typha latifolia*. At first glance we are reminded of the Soft Rush in the upper portion of the long, vertical stem, with its loose, pithy structure, yet the straggling upright panicle of spikelets recalls that of the Hard Rush, whilst the two flattened leaves showing at the base of the stem at once mark off a differentiation from the Rushes. The true Rush has cylindric leaves.

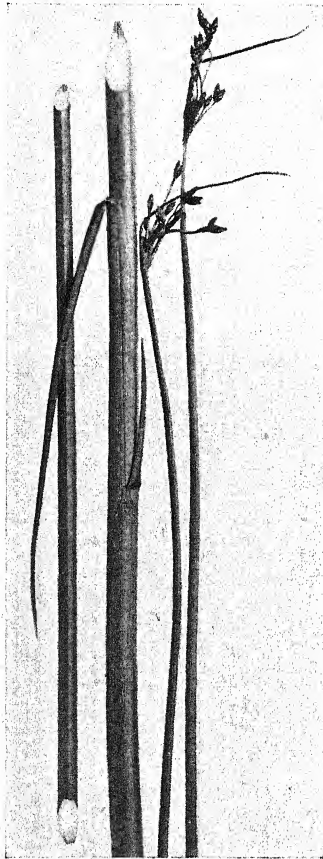
In respect of leaves, *Scirpus lacustris* is variable; they become flatter, longer and more grass-like when floating in running water, whereas in still water they are abbreviated and inclined to roll in upon themselves from the edges. The plant is also found in a leafless condition, when, of course, it approaches the Rushes in appearance more nearly. In height it surpasses either of the two species named, rising from three to as many as eight feet; the stem is always spongy rather than solid, although a section may measure an inch in diameter.

There is a subtle but distinct resemblance in the character of the umbel of flowering spikelets to that of the Flower-

ing Rush. These spikelets are a red-brown colour, forming oval, almost pointed groups.

Here we are reminded on the one hand of the three-angled stems of the *Carex* specialisation of the Sedges, and the grey, bloomy stems of the Hard Rush on the other. It is the same story woven within the history of all development of species, that of unity of possibility expressed in diversity, so that we may say quite reverently, "None is afore or after other, none is greater or less than another."

MAUD U. CLARKE.



SCIRPUS LACUSTRIS.

POND LIFE—II

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author



THE NEST OF THE WATER SPIDER.

ONE of the most interesting of the pond insects is the Water Spider (*Argyroneta aquatica*). Crawling and running over the broad, flat leaves on the surface of the pond, it does not attract much attention, for it looks like an ordinary spider with black, hairy legs and a brownish-grey body; but when it dives beneath the surface, the Water Spider becomes transformed into a striking and beautiful creature with a body that looks as if it were made of polished silver. This sudden change in appearance is due to the fact that the body of the spider is clothed with very soft and fine hairs, amongst which a film of air becomes imprisoned when the insect enters the water. This spider, indeed, is a veritable diver, carrying its own

air supply from the surface, down to the bottom of the pond. It may also be considered the true inventor of the diving-bell, for it builds a more or less dome-shaped home amongst the stems of the submerged weeds, and fills it with air, so that it looks as if it were composed of quicksilver.

It is a very pretty sight to watch one of these Water Spiders at work, filling its aqueous nest with air, and is one that may be easily witnessed by keeping a few of these spiders in an aquarium in which some water-weeds are growing. The spider will appear to be very busy amongst the stems of the water-weeds, moving rapidly from one to another, weaving fine silken threads that serve as foundations for his home. Except where the light

catches them at a certain angle, it is practically impossible to detect these threads, so that unless one is thoroughly acquainted with the habits and methods of the spider, one is rather apt to look upon its hurrying from one stem to another as a somewhat useless waste of energy, and an altogether profitless performance. In a little while, however, when the weaving operations have been more or less satisfactorily completed, the spider commences fresh tactics; it pays a succession of visits to the surface of the water, and each time it descends takes with it a large supply of air-bubbles. If we now watch the spider carefully, we shall see that at each descent it makes straight for the spot amongst the stems of the water-weeds, where it has been so busy, and proceeds with the aid of its wonderful comb-like claws to comb out from the body-hairs the entangled air-bubbles. This performance is repeated again and again, until the little dome of the "nest" becomes clearly visible, as though composed of burnished silver—an

effect produced by the imprisoned air which the spider has brought down from the surface and thus stored away. The Water Spider, like all her species, is armed with powerful, hollow jaws with a fine opening at their point, through which she sucks the juices of her prey, and many a soft-bodied water larva falls a victim to her guile.

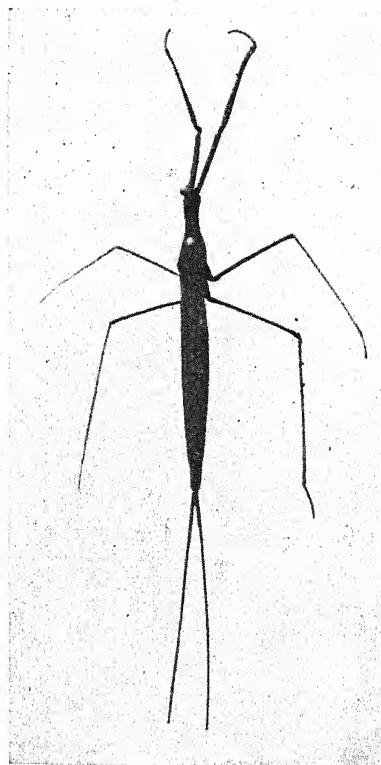
Mimicry plays an important part in the lives of many pond insects. For instance, a common object that is to be seen floating on the surface of almost every pond, and which at the first glance appears to

be a slender piece of stick, is the Pond-Skater (*Ranatra*). If we cautiously drop a small stone into the water, the little piece of stick suddenly becomes animated, and darts away, skimming over the surface of the water at a rapid rate. Looking closer, we see that what we at first mistook for a piece of stick is

really an insect, and that attached to the body are six very thin, fairly long legs. This Pond-Skater, or Pond "Stick" insect, as it is sometimes called, lives at the surface of the pond, and moves about with great rapidity by means of its delicate slender legs. It is in many respects a remarkable insect, and its movements are well worth closely watching. A few minutes' careful observation will reveal the fact that one of the insect's popular names, at least, is a very apt one, for it will be seen that the insect does not swim through the water, but actually skates along the surface without breaking the delicate surface film. When we come to consider how extremely attenuated are the limbs of the Pond-Skater,

we at once realise how impossible it would be for the insect to travel with such swift, darting movements if it had to propel itself *through* the water.

Another good example of insect mimicry—though one that it is not quite so easy to find as the Pond-Skater—is the so-called Water Scorpion (*Nepa cinerea*), which when resting amongst the brown leaves at the bottom of a shallow pool looks just like part of a withered willow-leaf. The insect is about an inch in length, and has a somewhat elliptical shaped body terminating in a pair of



WATER "STICK" INSECT OR POND-SKATER (*RANATRA*).

tail-like organs, which, when placed together, form a breathing tube. The rostrum or beak of the Water Scorpion is composed of three joints, and contains four sharp-pointed bristles, altogether a

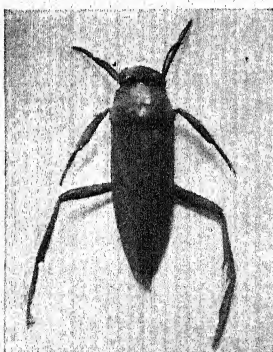


THE WATER SCORPION.

very complicated apparatus, and capable of inflicting a very painful wound. At the approach of danger the Water Scorpion can move with considerable rapidity, and quickly reveals its

true character. Under normal conditions, however, it creeps slowly about amongst the decaying leaves at the bottom of the pond, suddenly darting upon its prey, from which it sucks the blood by means of its short, complex beak.

A close and interesting relation of the Pond-Skater and the Water Scorpion is the Water Boatman (*Notonecta glauca*), which is generally to be found in the same ponds and slow-moving streams. This insect, as its popular name vaguely suggests, has its body shaped something like a boat,

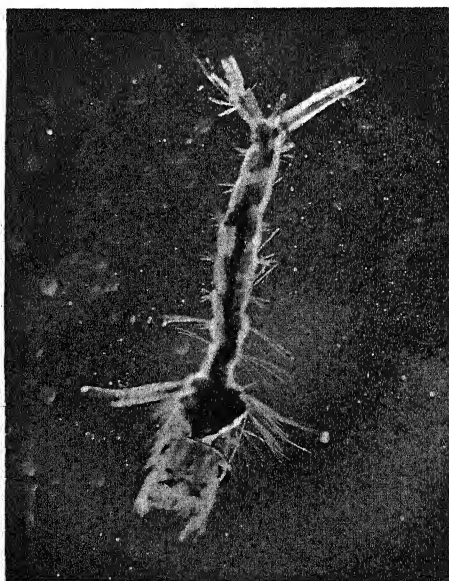


THE WATER BOATMAN.

convex above like the keel, flat below, with a large head and very large eyes. The front and second pair of its legs are short, but the hind pair are almost twice as long, are furnished with long hairs, resemble oars, and are used by

the insect to propel itself through the water. It is a most bloodthirsty and fearless insect; it attacks other insects much bigger, and apparently stronger, than itself, and also preys upon its own species.

Of very great interest is the life-history of the Gnats or Mosquitoes, not only because the early stages are passed in ponds, ditches, and shallow pools, but because some species in the adult stage of their existence are the transmitting agents of certain diseases—malaria and yellow fever among them—to man. The female Mos-



THE GNAT LARVA RISES TAIL FIRST TO THE SURFACE.

quito or Gnat lays her eggs in boat or raft shaped masses upon the surface of the pond, and from these eggs come forth quaint-looking little creatures with large heads adorned with tufts of bristles, and with fairly long slender bodies terminating in what looks somewhat like a double tail. They move through the water with rather a jerky, wriggling motion, and from time to time rise to the surface tail first, and stick the curious tail-like process which is attached at right-angles to the general outline of the body, and is called the syphon-tube, out of the water to take in

a fresh supply of air; for at this, the larval stage of their existence, they breathe through the curious tail-like organ. They feed chiefly upon the microscopic forms of life that swarm in the pond, but they are also great cannibals, and devour their younger and weaker brethren. They grow fairly rapidly, and from time to time, in consequence of their increasing size, cast their skins. Just

before the final larval moult they alter in shape, having a more bulky appearance in the region of the head and chest or thorax, until at last the skin is cast and the change which has been taking place beneath it is revealed. Then the head and chest are seen to be

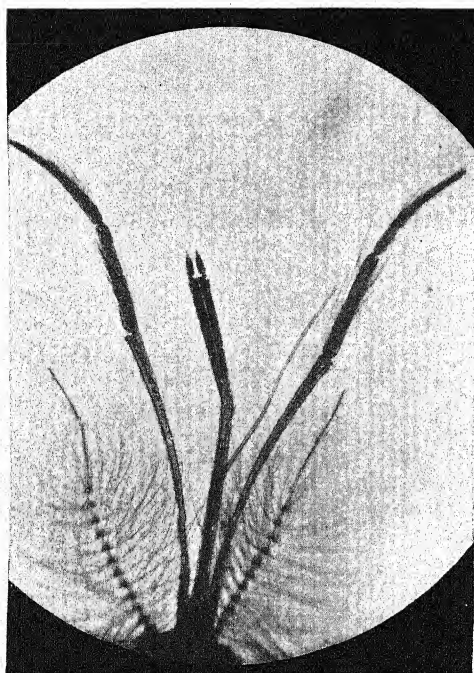


THE GNAT NYMPH RISES HEAD FIRST TO THE SURFACE.

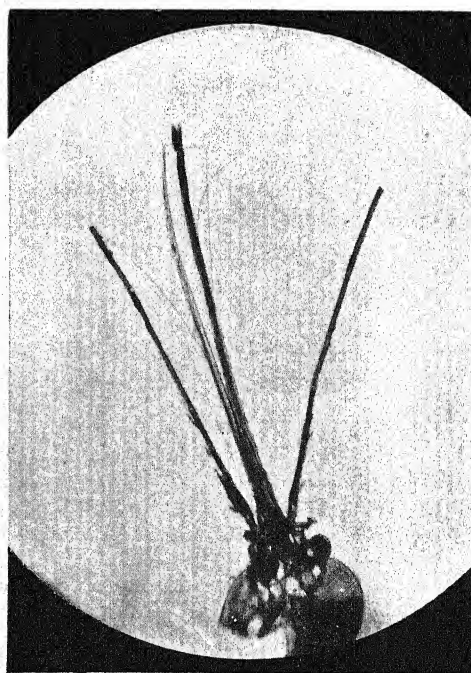
enclosed in a casing resembling in shape a kind of fireman's helmet, the body has shortened, and the double tail has changed to an extremity rather like the tail of a lobster. From the back of the "helmet," near the base of the head, spring two short tubes, and within the semi-transparent covering of the "helmet" can be seen the slender folded legs and wings of the future adult

Gnat. The insect has now reached the active nymph stage of its life, and now rises to the surface head first, poking out the two tubes on its back, through which it takes in the air supply.

When the final transformation of the Gnat is about to take place the active



HEAD OF MALE GNAT WITH PLUME-LIKE ANTENNÆ.

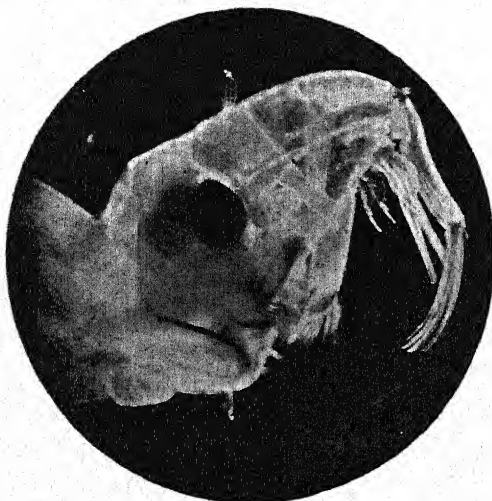


HEAD OF FEMALE GNAT WITH LANCET, ETC.

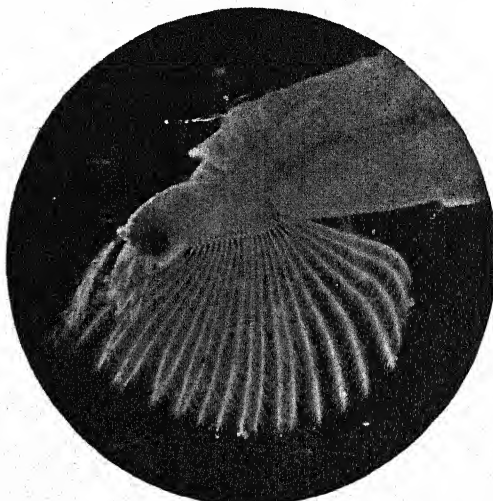
nymph rises to the surface and sticks its back well out of the water. The skin soon dries and cracks, and the perfect insect emerges. It rests for a short time on the old nymph-case, which serves as a raft, until its wings have dried and fully expanded, and then it flies away. Curiously enough, while the male Gnat or Mosquito is quite a harmless, inoffensive creature, and sucks only the juices of plants, the female is a most tormenting

while those of the female are comparatively simple in structure.

The life-history of the *Ephemeridæ*, or Day-flies, is a very curious one, for they are insects which last for the shortest time imaginable in their perfect state. Most fragile and delicate of creatures, they float away in the air from off the water, in which they have lived during the early stages of their existence, to spend the few brief hours of their perfect winged



THE GHOST LARVA HAS A FORBIDDING-LOOKING HEAD, BUT—



IS GRACED WITH AN EXQUISITE FAN NEAR THE EXTREMITY OF ITS BODY.

and bloodthirsty insect, greedily sucking the blood of man whenever she can get the opportunity. As might be expected, this diversity of food supply has led to a very considerable modification in the formation of the mouth-parts of the male and female Gnats; the stabbing or piercing lancet of the female is very highly developed. It is the female that is the transmitting agent of disease from man to man; it sucks the blood, for instance, of a man suffering from malaria or yellow fever, as the case may be, and so becomes infected and infective, for it absorbs along with the blood the parasite that causes the disease, and introduces it into the blood system of the next person it bites. The difference in appearance between the antennæ of the male and female Gnat is most striking; those of the male are beautiful plume-like organs,

life in graceful airy dancing and active courtship. Truly they are the most ephemeral of creatures!

The perfect insects are easily recognised; they have small heads, with large compound eyes, and short awl-shaped antennæ; the wings are very delicate, the front pair being the largest; the slender body is terminated by two or three long-jointed bristles, and the legs are very slender; the mouth-parts are often quite membranous in texture, for the insect apparently takes no food during the extremely short period of the perfect stage of its existence. The most familiar of the species, the May-fly, is a brown colour, banded with yellow, and has wings of a smoky hue with brown spots. It is a wonderful sight to watch the hundreds of these graceful insects, on an early summer evening, performing

their singularly elegant, dancing flight over a pond or shallow stream, rising and falling with a wonderfully rhythmic motion above the surface of the water.

The female May-flies deposit their eggs in little packets upon the water, and the larvæ on making their escape descend to the bottom of the pond or stream, where they lurk beneath stones, or excavate little burrows furnished with an opening at each end. The larval period lasts for a considerable time, probably two or three years, during which time the insects prey upon other pond larvæ, seizing their victims with the aid of their well-developed, sharp-pointed jaws. They continue to be active during the nymph stage, when the rudiments of the wings are visible. When the nymph is full grown, it crawls up the stem of a plant until it gets above the surface of the pond, and then waits while its skin dries and cracks down the back, and so enables the adult to emerge. But at this stage the creature is not quite perfect; indeed, it is a sort of pseudo-

perfect insect, for although able to use its wings for a short flight, all its parts are covered over and entirely enclosed in a very delicate membrane which completely hides the true colouring of the perfect insect. In this condition, the insect flies to some branch or other suitable resting-place, where, after an interval, this delicate membrane is ruptured, and the now perfect May-fly makes its escape and quickly flies away to join in the merry dance of its countless kin.

The *Corethra*, or Ghost larva, to be found in most ponds, is so wonderfully transparent that it can hardly be distinguished from the water in which it swims. It is a long and slender insect, and has a very formidable and forbidding looking head, but is graced with a most exquisite, delicate fan of hairs near the extremity of its body. The perfect *Corethra* somewhat closely resembles the common Gnat in general appearance, and is a small, brownish insect about a quarter of an inch long.

F. MARTIN DUNCAN.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE BADGER

THE BROCK THE GREY THE EARTH PIG

With Photographs by the Author

THE gardener, whose skill with animals appeals to me even more strongly than his skill with plants, has just brought word that my two Badgers, to wit, Sally and Jemima, have totally disappeared. Sally and Jemima live in a derelict green-house—from which a three feet climb would free them. But Sally and Jemima are of the earth, earthy. Now and again they rear full stretch and file their claws on the brickwork. With this their climbing ends. The heights hold out no promise. Their green-house is paved, or, rather,

was paved, with slabs of pottery; Roman in origin, I fancy, for at the last desecration of our local "villa" their counterparts were much in evidence. On the top of these slabs are bricks, piled with design to stack the corners. In driving slants Sally and Jemima greatly affect the corners; wherefore I have arranged that before they reach the tiles they must shift their tale of bricks. The weather governs these occasions, but, when the fit seizes them, the task seems easy enough. I have seen Sally with her head buried, and the bricks (good honest

bricks) flying like leaves behind her. Jemima must needs join in, but a heave from Sally's shoulders catches her and she flies headlong with the bricks, somersaults completely, and lands upon her broad grey back. Jemima's weight is

wards. You hear a snuffling, stifled grunt—Jemima's protest. The lorry lumbers past. Five minutes, and they reappear. "Idiot!" says Jemima, as plain as Badger's grunt can speak. But Sally's head is buried in the milk-bowl.



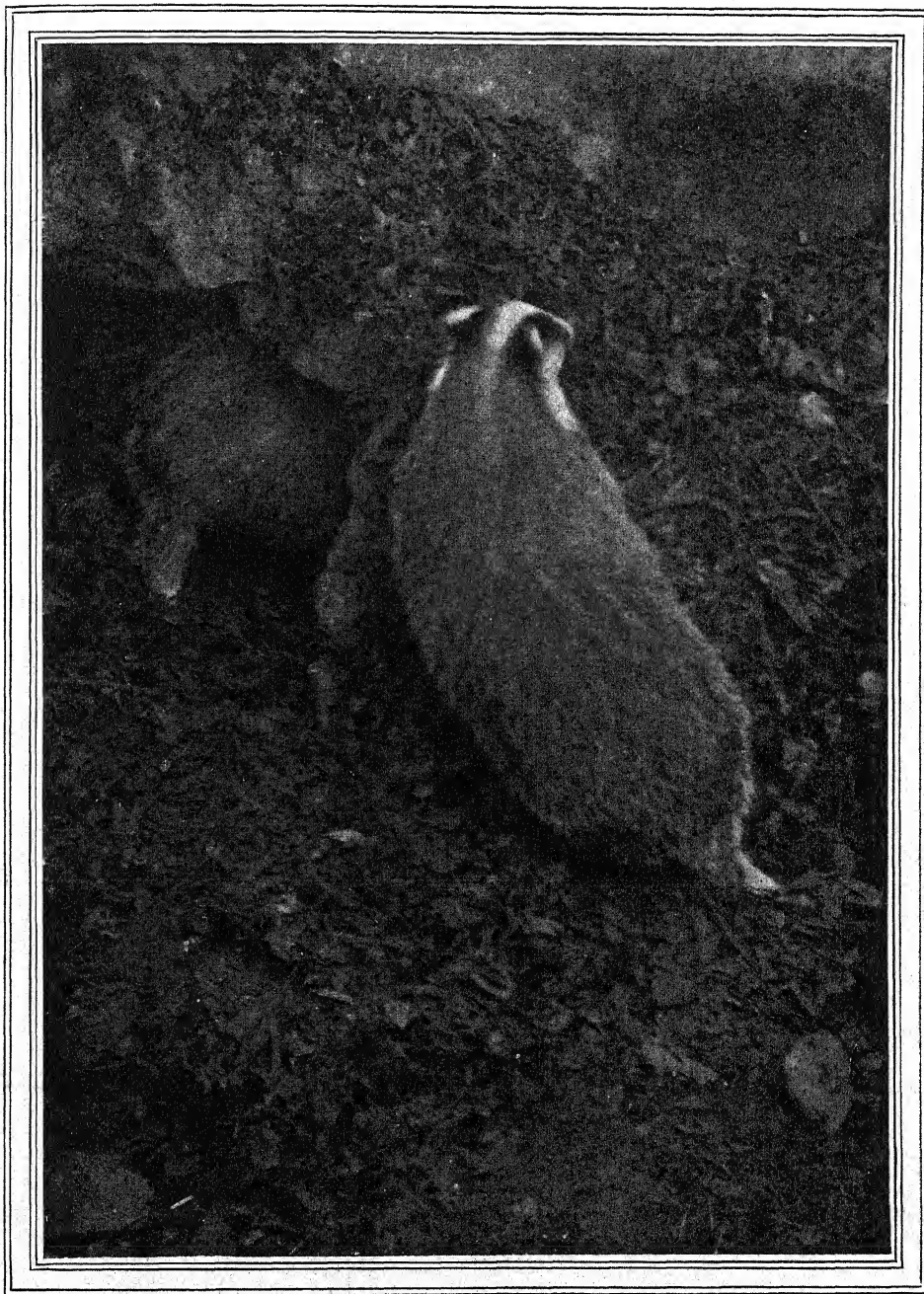
BADGER.

The stripiness of a Badger's coat is due to the fact that each of the long hairs is alternately banded from the root upwards, whitish, brown, black, brown, whitish again.

five-and-twenty pounds. Sometimes her help is welcomed, the bricks are scattered by joint effort, the slabs are wrenched asunder, and, snuffling with ecstasy, the pair of them reach Mother Earth. To vanish, then, is child's play, but, vanish whither they may, their course is limited. On all sides of them are ancient foundations proof even against a Badger's strength. At supper-time they reappear, dusty, shame-faced, and ravenous. Sally comes up first, pauses with fore feet tautened on the brink, snuffs at the air and listens. That sleep with Mother Earth has brought back memories. Last night the lorry might have clanked itself to pieces, but now the first faint creak of it (a furlong down the road) means instant pressing danger. She tumbles headlong back-

Jemima joins her, and, with much fuss, they drain it. Then to stretch their limbs. Nothing like "follow-my-leader" for this. It is Jemima's lead. She starts at a "low trot," head bent to earth, tail dropt, her fore feet criss-cross. These strike the ground flat-soled, her hind feet merely tiptoe; so her back sways and dances. Behind her trots her sister, pace for pace. Jemima wheels sharp right, instantly Sally follows. Jemima stops short, Sally even shorter. Jemima prances, Sally prances too. Jemima lifts her head up, Sally does the same. Jemima ducks her head and gallops to cover, Sally gallops after her.

It was I who startled them—with a careless swing of the lantern. There is only cover for one, for I have already



HOMeward BOUND.

It will be seen from this photograph that the black and white coloration of a Badger's head is extremely conspicuous under dull conditions of lighting. In theory it should be protective; in fact it is the first thing to catch the eye.

blocked the hole. Jemima promptly takes possession. Sally gives two powerful scrapes, and, heaving her bodily out of it, takes her place. Jemima gains her feet again and promptly returns the compliment. The air is thick with Badgers. Presently, however, they realise that it is only me, and venture out together side by side. This time I step between them. Sally goes right, Jemima left, both hug the wall, and, as neither will give way, collide on meeting. One or the other is cannoned outwards. Recovering, she takes her place in rear. So does their going revert to decency and due order.

This tendency to mimicry is a remarkable phenomenon in animals who, though unquestionably social in character, are not normally gregarious. Nor is the mimicry confined to movement. I have often found Sally and Jemima sleeping in a close embrace, stomachs upward, tails parallel, feet upturned symmetrically.

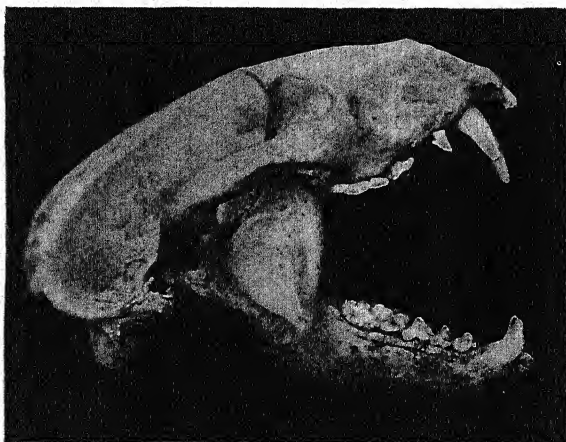
The Badger, whether we consider his

is "the oldest known species of mammal now living on the face of the earth."

Though placed originally by Linnæus among the Bears, the Badger is considered by modern systematists to be closely allied to the Weasels. If one was entitled to judge by character and external features, there would certainly be much evidence in favour of the older classification. In studying the Badger one misses the long flexible neck, the alert sparkling eye, the truculence of expression, and the quickness of movement which characterise the Weasel tribe; one is impressed rather by the bumping, criss-cross gait, the broad, shaggy back, the wedge-shaped head, and the apologetic tail.

These are ursine qualities. Bearish, too, are his modes of feeding—"gug and gumble and slobber"—his abandoned poses in sleep, his taste for sweets and stickiness, his slowness to wrath, his dogged courage, and his deep-toned warning growl.

It is possible that the ancestors of



A SIDE VIEW OF A BADGER'S SKULL.



B UPPER SURFACE OF SAME.

In A some of the teeth in the upper-jaw are missing. The small size of the premolar immediately behind the large canine in the under-jaw should be noticed. The gape of the jaws is the widest possible, the mandibles (under-jaw) having been allowed to hang free from their hinged articulation (see p. 679).

In B the enormous development of the central bony ridge, two and a half inches long in this case, and at its hinder end about a quarter of an inch high, and a quarter of an inch thick, suggests not only the solidity and strength of the attached head muscles, but also from a defensive standpoint the origin of the morion.

ancient lineage, his strength of character, or his strength of frame, whether we concern ourselves with the actualities of his structure, or the mysteries of his existence, is the most interesting animal in the country. So far as lineage is concerned, it will be sufficient for our present purpose to recall the opinion of Owen that the Badger

our modern European animals had of necessity to adapt themselves to greater variations of seasonal temperature than those which obtain at the present day. That a well-marked annual cycle still occurs in the case of the Badger is unquestionable. Midsummer finds him in the plenitude of his powers, a strong,

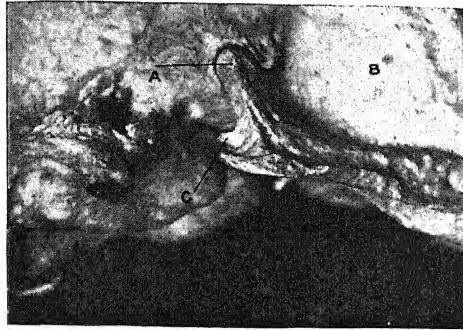
active, vivacious animal, who starts from his burrow before dark ("set" and "earth" are the sporting terms for a Badger's excavations, "set" perhaps the more sporting of the two), often wanders some miles afield, and does not dream of going home till morning. This is the pairing season—and the season of high living. Badgers eat almost anything—beetles in all stages, honey, bee and wasp grubs, young moles, young rabbits, and small vertebrates in general, grass, bulbs, leaves, and roots. Miss Maud Haviland, to whom I am much indebted both for

corroboration of my own notes on Badgers, and for permission to quote some interesting and original observations of her own, tells me of a remarkable fondness which they have for arum roots. Though the arum root under judicious treatment becomes the "Portland Sago" of commerce, the human being who essays to sample raw any portion of this plant will regret his temerity. Its poison, even in very minute doses, has a paralysing effect on the tongue and throat, which endures for a considerable time. The immunity which many animals enjoy in respect of certain vegetable, and even mineral poisons, whose action is dangerous in the case of human beings, is extremely curious, and would well repay investigation.

Towards the September equinox Badgers thoroughly clean out and relitter their burrows. I have never been fortunate enough to witness this operation, and I am again indebted to Miss Haviland, who in a recent letter to me describes the process as follows: "They twist up moss and dead grass in balls, and drag it in quantities into the burrow, so that a glade where they have been

harvesting looks as if a herd of pigs had been rooting there. I have known a case where the distance from the collecting ground to the hole was about two hundred

yards, through dense laurels down a hill side. They always drop a great deal on the way, and the nest takes about a week to make. I have put straw or shavings at the mouth of the burrow, and they have always taken it in if it is dry, but not otherwise. Once I made fast a string to a bundle of hay and pulled it up after they had taken the hay down. They had run out about fourteen yards of



THE ARTICULATION OF THE BADGER'S MANDIBLE.

- A. The condyle fitting into the glenoid cavity.
- B. The coronoid process of the mandible.
- C. The angular process.

The transverse measurement of the condyle is about seven-eighths of an inch, and the articulation admits of an up and down movement of the lower jaw through about 40 degrees, and a lateral displacement through about an eighth of an inch. The front border of the glenoid cavity overlaps the condyle on the outer half, and the hind border (not visible in the picture) on the inner half. Dislocation without fracture is impossible.

string—but that is not long for an earth. There is one on the Courtown Estate (Co. Wexford) which is at least a hundred yards long, but I suspect that this is connected with an old drain. At one time all the Badgers at Courtown were exterminated, but in a few years the burrows were again occupied. Nine Badgers were killed on one estate in Kilkenny in 1907. They used to be very common there, and on one occasion one of the family looked out of the window at midnight and saw three Badgers just outside the hall door. They used to dig up any crocus, tulip, and snowdrop bulbs which were planted round the house, but they never touched daffodil, bluebell, or hyacinth. I think that the slimy juice in the latter's shoots deterred them."

The fresh nest which Badgers construct in September is designed for winter quarters. As the cold approaches Badgers get more and more sluggish, leave their burrows later, and return to them earlier, until, by the time mid-winter is reached, they will often remain without food for days, and are only tempted out by extremely genial and unseasonable conditions. From mid-winter onwards



RECONNOITRING.

they gradually resume their activity, and at about the March equinox they have a complete spring-cleaning and a second re-littering of their nests. This is in anticipation of the arrival of the cubs. The normal gestation of the Badger is about seven months. It is probable that the cubs are weaned at about six weeks, and so the parents come back to the pairing season once more (barring accident Badgers pair for life), and the annual cycle recommences.

In an animal whose burrowing power is so remarkable (in almost every district where Badgers are plentiful there are traditions of vast subterranean galleries extending a mile or more and reaching a depth of at least a hundred feet), whose enormous strength is combined in most cases with gentleness and extreme shyness, and whose persistence as an unaltered type from very early times is generally admitted, one expects naturally to find unique peculiarities of structure. I will leave my photographs to give a general idea of the Badger's coloration, and of the extraordinary articulations of his mandibles, which remain locked to the skull even after the powerful muscles and ligaments which control them have been completely removed. It is evident that

with an arrangement of this kind the jaws cannot be dislocated without fracture, and that, when once a Badger has got his teeth home, it will be extremely difficult to make him loose his hold. Sir Alfred Pease, in his excellent little book on the Badger—to which I would refer my readers for an entertaining and well-written account of the animal from a sporting as well as from a zoological aspect—gives the following gruesome instance of this power of grip: "The Badger held him (a keeper) by the wrist for ten minutes with his arm stretched up the hole; when he let go his hold the hand was hanging by a few shreds, and had, of course, to be amputated." A man's wrist crosswise in a Badger's mouth would be an object of just the right proportions to get full work out of the specialised jaw mechanism, and the laceration would of course be increased by the man's endeavours to free himself.

With the note that the abnormality of the extensor muscles of a Badger's fore-limb was held by Cuvier to augment greatly its power as a digging tool (a Badger's fore-feet, besides possessing larger claws, are in themselves consider-



GOING OUT.

ably larger than his hind feet), we may pass to a short consideration of the extraordinary glands situated beneath the root of his tail. I may say at once that the proverb "to stink like a Badger" is, like most proverbs derogatory to animals, a gross perversion of fact. A Badger kept under reasonably fair conditions is as clean and sweet an animal as exists. It is probable that the proverb had its origin in the bestial custom of Badger-baiting, which implied keeping the animal in a barrel or in similarly confined quarters until there was a sufficient entry of dogs to pay the publican. The functions of a Badger's subcaudal glands have been ably investigated by Professor Herbst of Göttingen, and I entirely agree with his conclusions that whatever their use may

be in the mature Badger, the immature Badger regards their secretion as a condiment and possibly as a nutriment. The continual attention which baby Badgers pay to this portion of their anatomy cannot fail to strike anyone who is fortunate enough to have experience of baby Badgers, and though mature Badgers are inclined to seek similar consolation by sucking their thumbs for hours together, they are by no means averse to directing their muzzles elsewhere. It must not be forgotten, however, that portions of the body which continually exude viscous matter are continually in need of cleaning, and that the application of a mature Badger's tongue to his subcaudal glands may be analogous to the application of the handkerchief to the human nose.

DOUGLAS ENGLISH.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

THE ELDER, THE HOLLY, THE LABURNUM
AND THE ACACIA

THE ELDER

THOUGH generally seen growing as a somewhat straggling bush, the Elder not infrequently becomes a small standard tree. It is common in all the countryside, but it seems to have a special preference for the neighbourhood of human habitations. This may be due to the regard in which it has been held as the possessor of certain medicinal and other virtues. It may be due to use and custom, but it always seems to strike a homely note in our landscape, and, whether seen in full flower or in berry, it wins a kindly notice.

Its habit of branching is very distinct-

ive. As a rule several stems rise from the base, and these bend over, drooping at the tips. Along these, especially at the supreme curve, rise other upright stems, which likewise bend over. Many similar shoots also rise upright from lower down on the main stems, at short distances apart, like whipstocks. The branching, besides being irregular and straggling, has the appearance of cross-hatching, and is in parts overcrowded.

The bark, with age, becomes rough and deeply furrowed; its colour is a yellowish brown. The twigs are a pale greenish grey marked with distinct patches of yellowish brown, indicating the presence of numerous breathing apertures. Twigs

and shoots have but a thin outer woody coating, all within being soft pith. The buds are arranged upon these in opposite pairs. They have a few loose scales at the base, above which the tips of the young leaves are seen as green unprotected tufts throughout the winter.

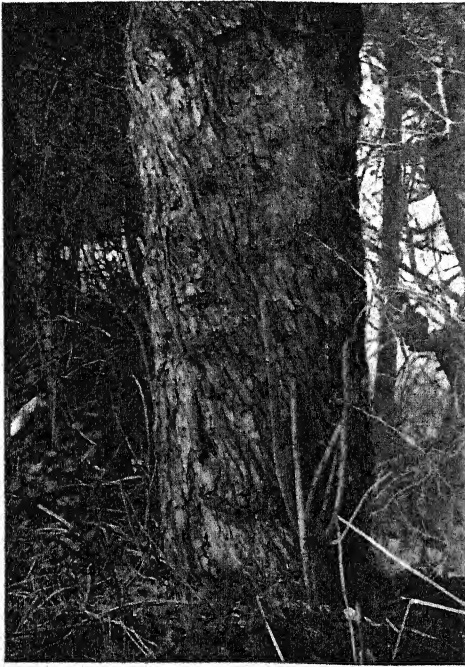
The leaves are compound, made up of

and in this way its contained seeds are effectively dispersed.

THE HOLLY

The Holly can never be mistaken, whether met with as hedge, bush or tree. Its use in our Christmas decorations has assured that. It may be found by almost every wayside, and is often abundant as woodland undergrowth. It is most distinctive when other trees are bare of leaves, but not only for the fact that its leaves remain. Its ripe, red, coral-like berries, crowded on the twigs amongst its rich green, varnished foliage, render it conspicuous at this season, spreading a rich glow of colour in striking contrast to the wintry surroundings.

The bark is smooth, ashen grey in colour, recalling that of the beech. The leaves, dark green and polished, thick in substance, hard and leathery in texture, are typical ever-

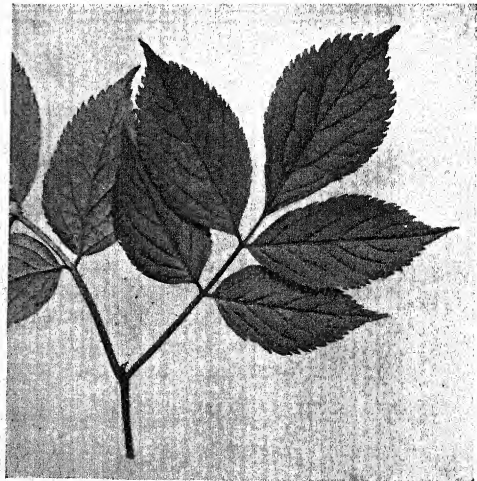


TRUNK AND BARK OF ELDER.

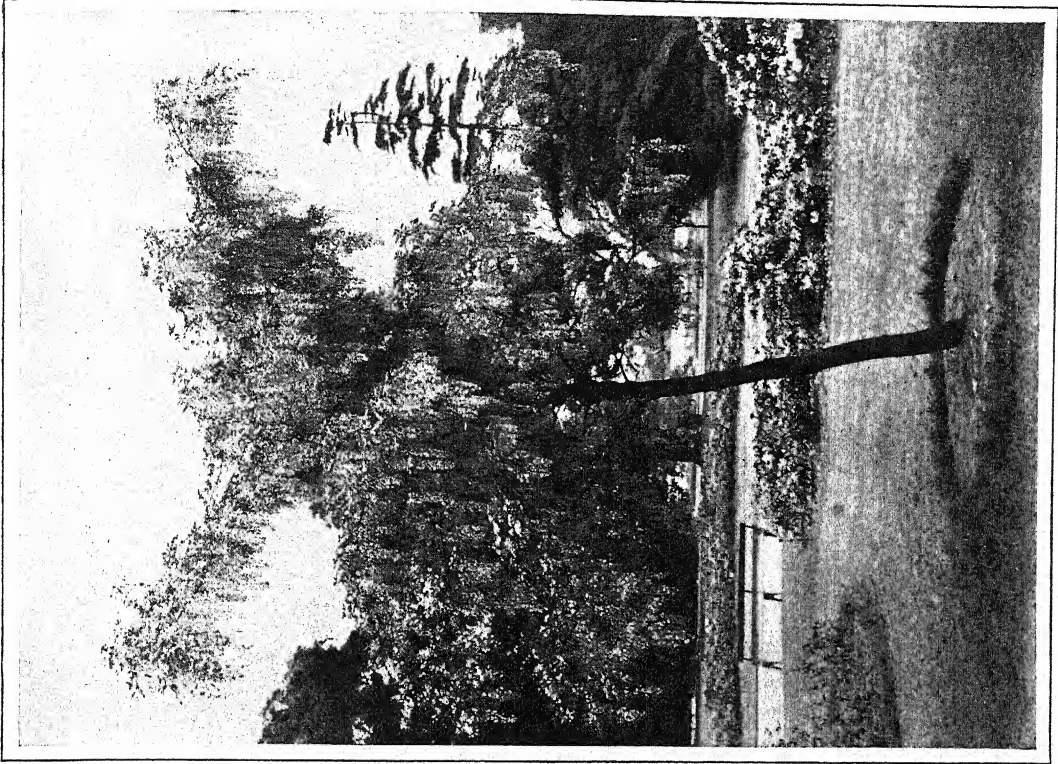
from two to five pairs of leaflets with a single terminal one. These leaflets are oval and pointed, having their margins rather coarsely toothed. The flowers are individually small, with five creamy white petals. They are made conspicuous by their grouping into a rounded flat extension, which suggests a platter upheld on a five-branched support. They secrete no nectar, but are much visited for their pollen by many kinds of flies, to whom their rather disagreeable scent is evidently an attraction. The fruit, upheld in the same way, and grouped as the flowers, takes the form of a stone fruit, small, round, having three stones embedded in its juicy pulp. It is eagerly swallowed by numbers of small birds,



ELDER TWIG.



ELDER LEAVES.



LABURNUM.



ELDER.



TRUNK AND BARK OF HOLLY.

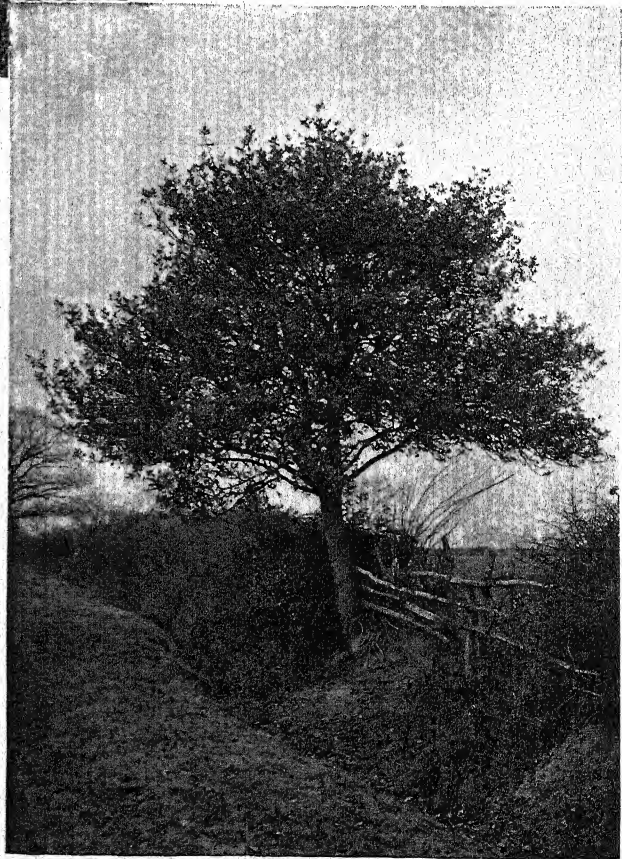
green leaves, adapted to withstand and endure stress of winter. Their margins are plentifully armed with sharp spines, and as the leaves are spirally arranged on the twigs, and moreover as each leaf-blade curls and twists, these sharp points are presented in every direction, thus affording a sure protection against browsing cattle. They are, however, no defence against cropping by deer. There is a noticeable tendency to forego this defence on the higher branches, where the necessity for it is lessened by their being out of reach. This cannot, from the evidence afforded by our native Hollies, be defined as more than a tendency. The leaves, according to Dr. Groom, remain attached for about four years.

The small flowers, having

four creamy petals, are crowded together at the base of the previous year's leaf-stalks. They are, as a rule, incomplete, having only rudimentary stamens or pistil, but the flowers on each tree are usually in agreement. In consequence of this some trees display no winter crop of berries. The fruit, however, is not a berry. It is a stone fruit with four stones. As the bright colour and pulpy substance of the fruit would lead us to expect, the seeds in their hard shells are dependent upon the birds for their dispersal.

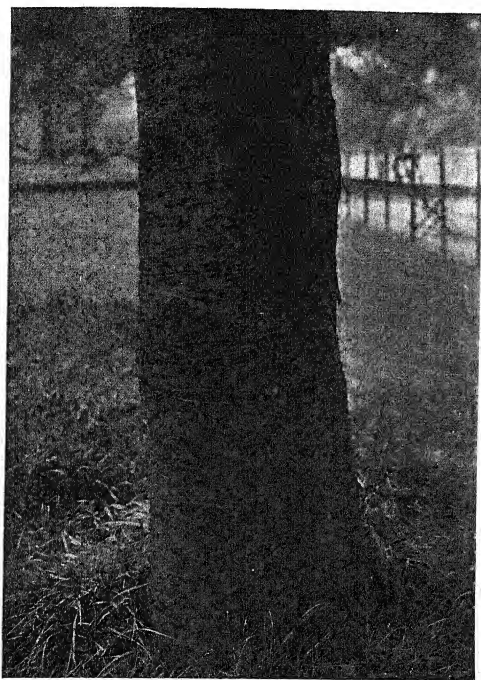
THE LABURNUM

The pea-pod tribe of plants is one of the most extensive. It includes, amongst herbs, the peas and beans, the vetches, the clovers, and many others; amongst shrubs, the broom and



HEDGEROW HOLLY.

gorse, and amongst trees the Laburnum and Garden Acacia. It is not only distinguished by its fruit, but also by



TRUNK AND BARK OF LABURNUM.

its flowers. These, with modifications, may be described as having wing-like petals, suggestive of a butterfly's wings, and boat-like petals, which by the union of two constitute a very fair representation of a boat's keel. An examination of these flowers, and comparison of one kind with another, are of special interest as showing the various adaptations and devices by which their fertilisation by insects is governed and accomplished.

The Laburnum, so common as a small tree in gardens, can never be mistaken when in bloom. Its branches, curving with the weight of their drooping yellow tassels, suggestive of "golden rain," make it familiar and a favourite. It is not a native tree, but it is completely naturalised. Yet it is seldom,

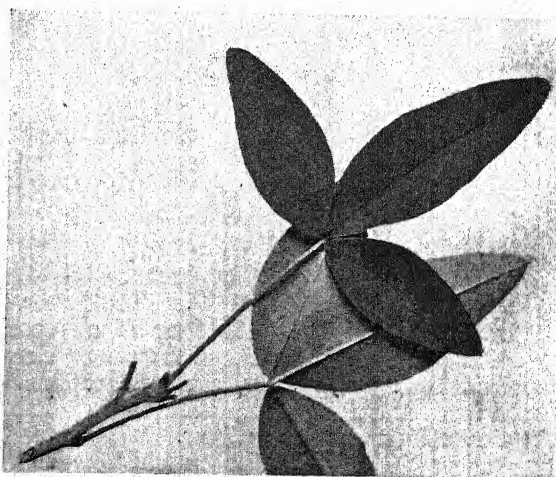
if ever, found growing wild. This is the more remarkable from the fact that its seeds readily germinate, and its seedlings spring up freely as garden weeds. A suggested explanation is that, in the open, these seedlings never escape the attention of the rabbits, to whom they prove a dainty morsel.

The bark is smooth, eventually peeling off in transverse strips. The twigs are green, becoming greyish as their outer skin flakes off. The buds are arranged spirally on the twigs. They have three scales, and are coated with silky hairs. The leaves are compound, having three leaflets. These are elliptical in shape, and without marginal teeth. Their under surface is pale and silky. They are attached by very short stalks to the end of a long main stalk, but as dwarf shoots are very numerous the leaves usually appear tufted.

The flowers are congregated in the form of clustered tassels. These droop gracefully, but each individual flower, when expanded, stands out horizontally



LABURNUM TWIG.

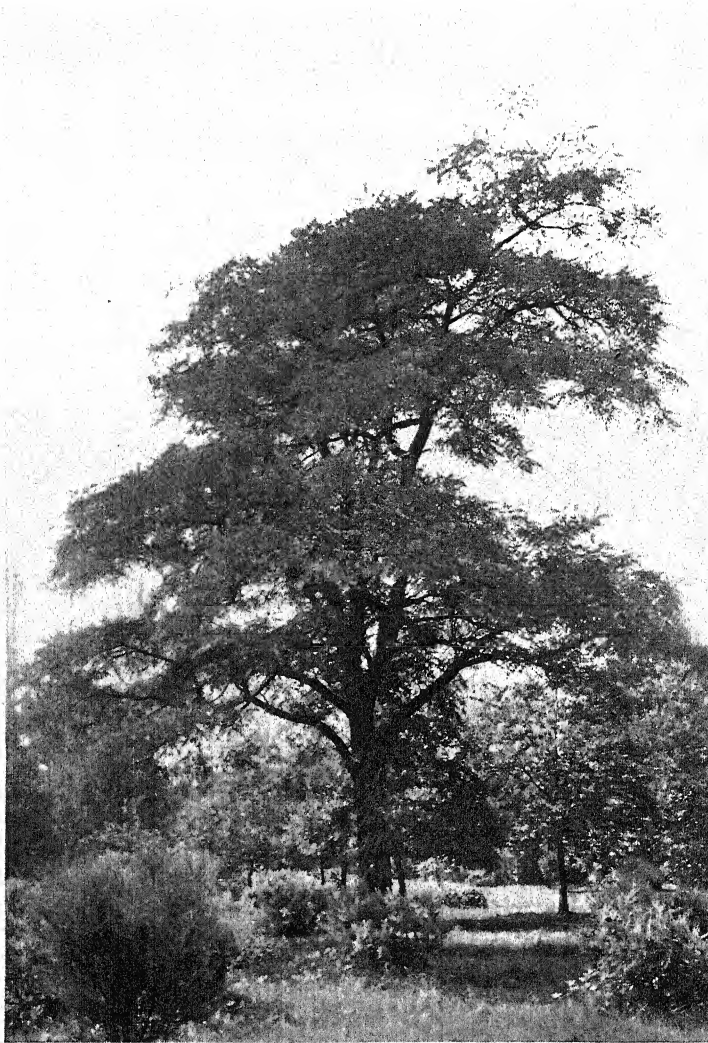


LABURNUM LEAVES.

in a manner best suited to a bee's alighting. Their colour is a golden yellow, but in one variety they are pink or purple. Two dark lines on the upright petals serve as guides to the concealed

THE ACACIA

This ornamental and interesting tree is sadly in need of a name. As the result of one error it has been named Acacia, and of another Locust Tree. Botanists

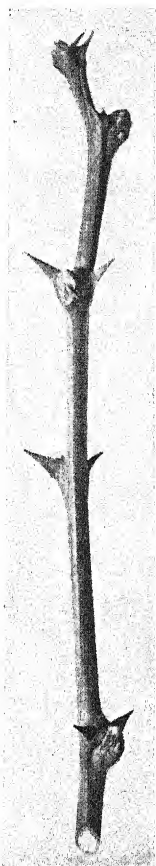


ACACIA.

nectar. The fruit is in the form of a yellow or brown pod. Several of these are attached to a single stalk, and several stalks form a cluster, which remains on the tree all through the winter. When ripe the pod opens, splitting lengthwise, and the black seeds escape.

speak of it as False Acacia, which is simply libellous. Acacia "falsely so called" would be more correct. White Laburnum is misleading, and Garden (or Gardener's) Acacia is almost equally so.

A considerably larger tree than the



ACACIA TWIG.

is to lessen transpiration and consequent chilling.

Laburnum, it has much in common, particularly in respect of its flowers and fruits. The bark, which is brown in colour, becomes deeply furrowed and uneven, having raised ridges forming a lattice-like pattern. The twigs are olive to brown. The buds, arranged spirally, are entirely hidden in a large angular leaf-scar which lies between two projecting spines. The compound leaves consist of from five to twelve pairs of leaflets with a terminal one. These are oval in shape and without marginal teeth. They are thin in substance, smooth in texture, of a bright green above, bluish below. Like the leaves of the Laburnum, the clovers, and some other plants of this order, they close one over another, and become pendent at night, suggestive of sleeping.

The purpose of this

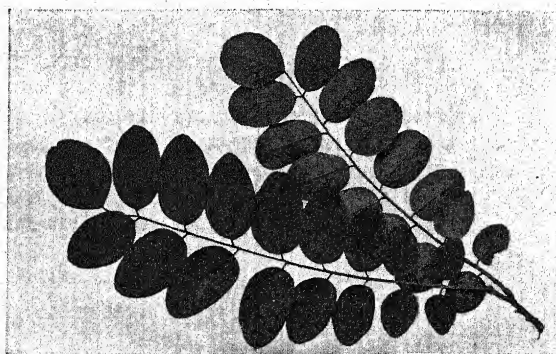
The flowers are white, fragrant, and hang in pendent tassels, after the manner of those of the Laburnum. They pro-



TRUNK AND BARK OF ACACIA.

vide abundance of nectar. Some varieties have yellow, and others rose-coloured, flowers. The fruits are dark red flattened pods, containing six or more seeds.

HENRY IRVING.



ACACIA LEAVES.

THE STORY OF THE MOULDS

By JOHN J. WARD

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.

With Photo-micrographs by the Author

THE mysterious, fluffy growths known as "moulds" are familiar intruders in every household. They readily attack such food materials as jam, cheese, bread, pickles, ripe fruit, etc., and on these substances they flourish amazingly, as every housewife well knows; likewise, old boots, paste, wall-papers, books, and many other household commodities offer them suitable quarters.

Most persons are very much surprised when they first learn that each little fluffy mould patch that appears upon their food, or other materials, is, in reality, a dense, miniature forest;

yet such is the case. It is true that the tiny plants that inhabit these forests are not altogether analogous to those with which we are familiar in our woodland rambles. To make the analogy complete we should have to reconstruct the scene somewhat.

Let us imagine that all the elm, oak, fir, and other large forest trees were felled, and that those weird-looking fungi that stand out boldly in the moist corners of the wood then spread themselves all over the land and occupied the place of the trees, and at the same time grew to

the same height as the trees. Then we should have a mammoth mould forest; for moulds are but minute mushrooms or other fungi of proportionately tall growth.

Those readers of THE NATURE BOOK

who possess a microscope of low power may, by aid of that instrument, peep into the depths of these mould forests. In the illustration on this page I have shown a bird's-eye view, as it were, of the corner of one of these forests flourishing on the surface of a pot of jam, as it appears when magnified 20 diameters.

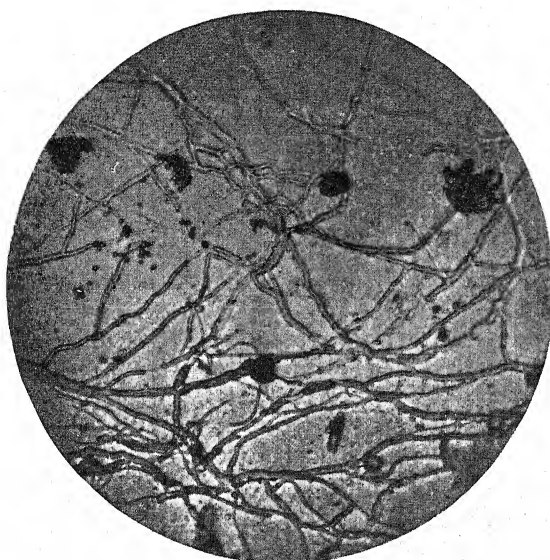
Below it is seen to be a dense carpet of felt-like growth,

while springing from this are innumerable tall filaments bearing large and conspicuous heads. This felt-like growth is the vegetative part of the fungus, corresponding to the branches and roots of other plants, according as they remain above or penetrate the surface on which they are developing; while the tall filaments with the conspicuous heads may be likened to the flowering branches of other plants.

Fungi, however, are entirely devoid of the roots, stems, leaves, and flowers so characteristic of familiar plants; neither



A MOULD FOREST GROWING ON JAM.
(Magnified 20 diameters.)



THE MOULD PLANT EXTENDING ITS BRANCHES WHICH GIVE ORIGIN TO THE SPORE-BEARING PARTS.
(Magnified 100 diameters.)

do they produce seed. The "seed" in the case of fungi is termed a spore.

Immediately the minute spore reaches some suitable substance on which it can develop, it commences to send out a delicate, thread-like structure termed a *hypha*, which grows rapidly, forming branches which permeate in all directions the substance on which it is growing, as shown above. The *hyphæ* extend so quickly that in the course of a few days they begin to form the thick felt-like growth previously referred to, which is called the *mycelium*.

From the *mycelium* there then appear numerous *aerial hyphæ*; and eventually these produce at their summits the apparent flowers. These structures, however, when ripe, are seen to consist of numerous short branches crowded together in brush-like heads; each little branch as it develops becoming a row of rounded spores. In the lower illustration on this page are shown some of these heads magnified 130 diameters.

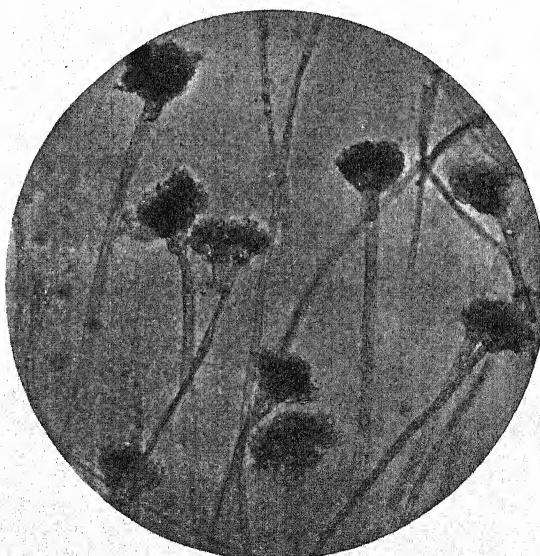
The whole structure of these mould plants is very simple; the *hyphæ* are composed of long tube-

like cells filled with protoplasm, or living matter; there is none of the complex and specialised cell-structure such as we are familiar with in all parts of the higher plants. The structure of these lowly organisms is much the same throughout; their "roots," "branches," and spore-bearing parts all bear a structural likeness; even the rows of spores are but branches of the *hyphæ* divided into minute bead-like constrictions.

Structurally considered, they only differ from the lowest of known plants (whose structures are homogeneous throughout, and often consist of only a single cell) in the fact that the plant body is divided into distinct vegetative and reproductive parts.

It is only in a few species that anything of the nature of sexual reproduction is known, and that aspect of the subject need not concern us here. The non-sexual method of reproduction we may, however, now consider, for it is by that means that these lowly fungi are so largely propagated upon food and other materials.

From the innumerable spore-bearing



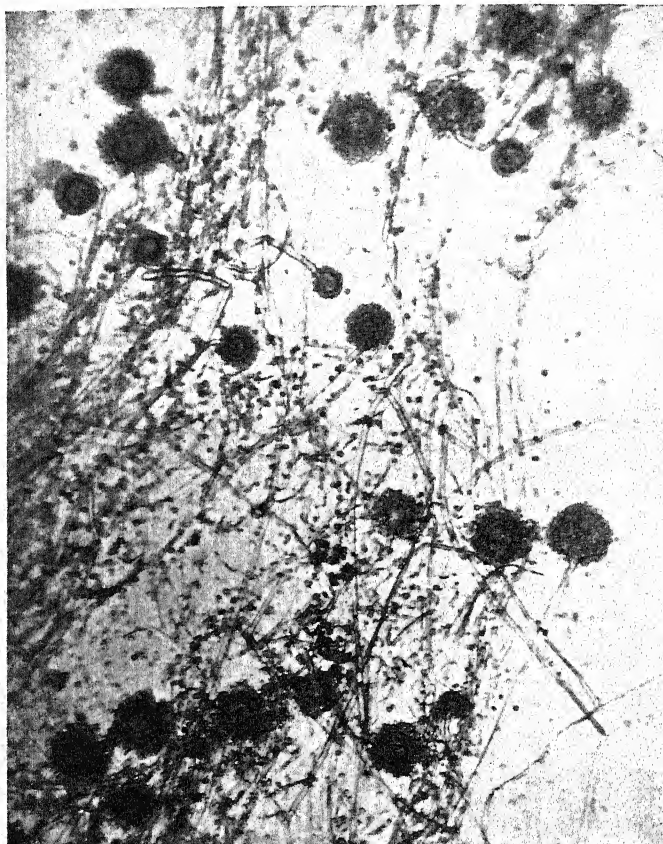
SOME OF THE HEADS OF SPORES SHOWN IN THE ILLUSTRATION ON PAGE 688.

(Magnified 130 diameters.)

heads come myriads of ripe spores, and so minute and light are these non-sexual spores (which, as I have previously explained, are but minute constrictions of the reproductive branches of the

examples of similar but more malignant organisms.

When, however, the spores that float in the atmosphere settle upon an exposed article of food or some moist organic



BLUE MOULD ON CHEESE.
(Magnified 60 diameters.)

hyphæ) that they are removed from the spore-heads by the slightest breath of air. The air we breathe often contains large numbers of such tiny spores; thus the smell of mouldiness is a sufficient indication to us that, in all probability, we have inhaled several hundreds of these invisible mould germs. Usually, when thus disposed of, they do little or no harm, but the germs of some other lowly fungi may, on the contrary, be extremely mischievous; the microbes or bacteria that produce disease in man and domestic animals are

product, such as I have previously mentioned, they at once commence to germinate and spread their *hyphæ* through the substance; and so, in a few days, another mould forest is produced, from which millions of spores arise and are wafted into the atmosphere.

These fungi being parasitic on decaying organic matter, naturally flourish on such materials as jam, pickles, cheese, bread, etc., for such materials are but decaying substances. Whenever in our methods of food preservation a weak spot, due to souring or fermentation,

arises, we may know that fungi or bacteria have made their appearance. A piece of cheese, that is apparently quite sound one day, may on the next develop a mould-covered surface that hourly waxes larger. The explanation is, of course, that the substance of the cheese has reached that stage of ripeness where decay or a dissolution of its chemical equilibrium sets in, and this state gives opportunity for the germination of the mould spore. Hence the necessity for refrigerating or canning articles of food as a means for their preservation. The importance of carrying out methods of preservation in a thorough manner cannot be too much insisted on; the slightest opportunity of attack is immediately seized upon by the enemy.

On page 690 is shown some of the familiar Blue Mould (*Aspergillus*) that develops on cheese magnified 60 diameters. In this photograph

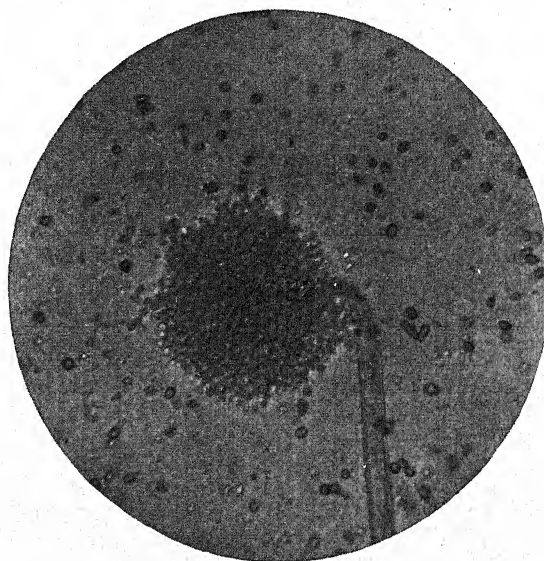
the *hyphæ* and the spore-bearing branches are clearly seen, and also we observe that innumerable spores are being scattered in all directions. Now I will ask my reader to imagine what happens when the cheese-dish is brought to the table and the cover removed.

The piece of cheese included in this photograph is scarcely larger than a pin's head, yet numerous spore-heads appear; on the whole surface of the cheese upon the dish, however, there may be many thousands of spore-heads. Immediately the dish-cover is removed, the inrush of air causes every ripe head to burst and scatter its spores. In the illustration on this page I have photographed one of the

ripe heads in the act of scattering its spores under a magnification of 200 diameters, or, more popularly speaking, 40,000 times; probably this picture will explain better than a volume of words how these tiny germs may infest an atmosphere. It is obvious that the air at once becomes loaded with spores, each of which may be the parent of another mould forest.

In the last picture another mould species is shown, a form that frequently grows upon moist bread or paste. It will

be seen, therefore, that these minute fungi differ in form just as do their larger relatives the more familiar toadstools and mushrooms. It is the *mycelium* of the mushroom that constitutes the "spawn" used for mushroom propagation, while the mushroom itself is an agglomeration of the spore-bearing branches or *aerial hyphæ*, such as we have glanced at in the delicate moulds.



ONE OF THE RIPE SPORE-HEADS SEEN IN THE ILLUSTRATION ON PAGE 690.

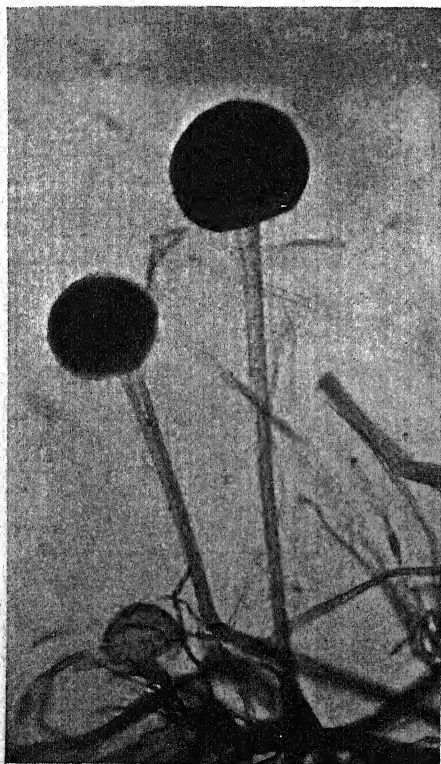
Photographed in the act of scattering its spores into the atmosphere. (Magnified 200 diameters.)

Unfortunately, the depredations of these minute and lowly organisms extend far beyond our food materials and household commodities. There are numerous forms that attack and thrive upon living plants, eventually bringing about their destruction; indeed, it is probable that every living plant has some species of mould or fungus that preys upon it; some unfortunate plant hosts are victims to quite a large number of such enemies.

When the gardener looks grave and talks of mildew, rot, canker, scab, smut, bunt, leaf-curl, leaf-blotch, fungus disease, etc., we may know that the minute but destructive fungi we popularly term

"moulds" have been destroying his produce.

Sometimes, in agricultural districts, whole crops of grain and fruit are completely ruined by these pests; indeed, where a particularly virulent species gets the upper hand, it often means that vast areas of land are completely devastated;



A MOULD THAT GROWS ON OVER-RIPE
FRUIT, BREAD, ETC.
(Magnified 60 diameters.)

desolated vineyards and famine frequently being the outcome of its destructive work. Vine mildew, potato disease, onion mildew, American gooseberry mildew, etc., are foes of this order, all greatly dreaded by the agriculturist.

I have previously stated that every plant probably has its fungus parasite; it is remarkable, however, that the familiar mushroom, and various toadstools, should suffer from parasitism of the same class. Cultivated mushrooms are often attacked by a minute mould or fungus (*Hypomyces pernicius*) that distorts the spore-bearing

parts (*i.e.* the mushroom) until they become swollen and diseased masses. Such parasitism is analogous to that which inspired the poet who penned the famous lines:

"Little fleas have smaller fleas
Upon their backs to bite 'em,"

and, seeing that eventually these secondary parasites themselves become the prey of still more simple fungi (bacteria), we may add the remainder of the poet's verse:

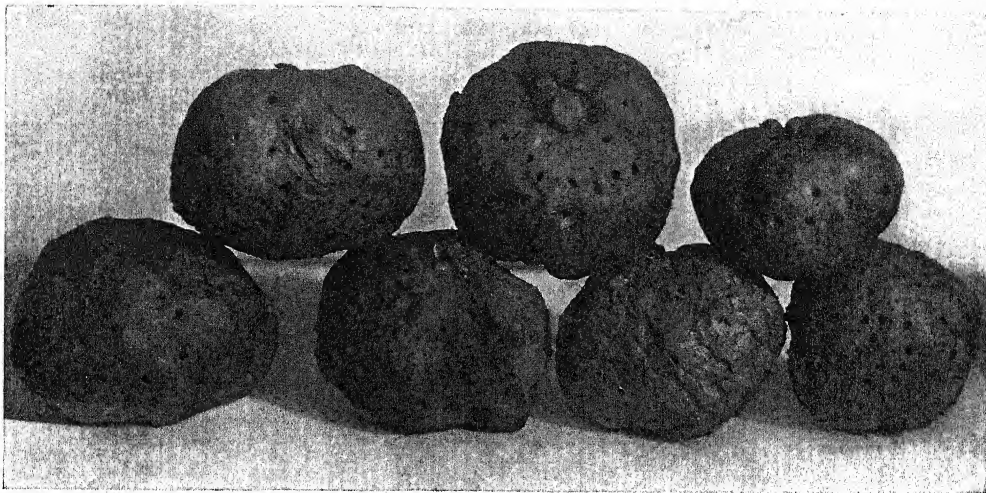
"And these again have lesser fleas,
And so *ad infinitum*."

for where such parasitism ends it is difficult to say.

In the same manner animal life is equally open to attack by these imps of mischief. Man and domestic animals suffer from innumerable diseases entirely due to these lowly organisms; hence it is the aim of modern surgery, in the dressing of wounds, in operations, etc., to prevent access to bacterial germs (which are moulds reduced to their lowest terms), and by the use of antiseptics to destroy their virulent properties.

While these minute fungi are bad masters, they, nevertheless, may become very good servants. By their orderly working we are enabled to prepare many valuable food materials, such as bread, beer, wine, vinegar, cheese, etc.; while others of their kind, by their united action, are continually renewing the fertility of the soil. Even in their most destructive moments they are carrying out a useful function in Nature's economy; although, I fear, it would be difficult to persuade the farmer thus far who has lost a valuable crop by their baleful agency. Nevertheless, Nature is clearing off her score. The spore of the vine mould cannot penetrate the tough skin of the perfect and healthy grape; not until it ripens and turns soft, as decay is approaching, can it make an attack; likewise, the weak and badly cultivated crop is always open to receive the enemy, for Nature abhors the weakling, and is ever ready to lay it low. The lowly fungi constitute the scythe by means of which she cuts it down; only, though, to reconvert its dead and putrefying substance into new and more perfect life forms. The fungi are Nature's scavengers that sweep her garden path and keep her house in order.

JOHN J. WARD.



OAK APPLES IN AUTUMN AFTER FALLING FROM THE TREES,
Showing holes through which the flies emerged in June.

WHAT IS AN "OAK APPLE" ?

By HAROLD BASTIN

With Photographs by the Author

VEGETABLE galls are among the most familiar objects of the countryside, yet most people have a very hazy idea as to their origin and significance. Certain kinds were—and, indeed, are still—thought to be a queer kind of fruit; witness the popular name "oak apple." Another commonly accepted but erroneous theory with regard to other galls is that they are a fungoid growth. As a matter of fact, galls are a part and parcel of the plant on which they are found, albeit a morbid growth, and are generally the outcome of irritation caused by insects. Some well-known galls, such as the variously coloured "nail galls" on the leaves of the lime, and the red, globular galls on those of the maple, are due to the activity of mites—minute creatures more nearly related to spiders than to insects. It is, however, with an insect gall that I propose to deal; to trace,

in fact, the "life history" of that familiar object—the common oak apple.

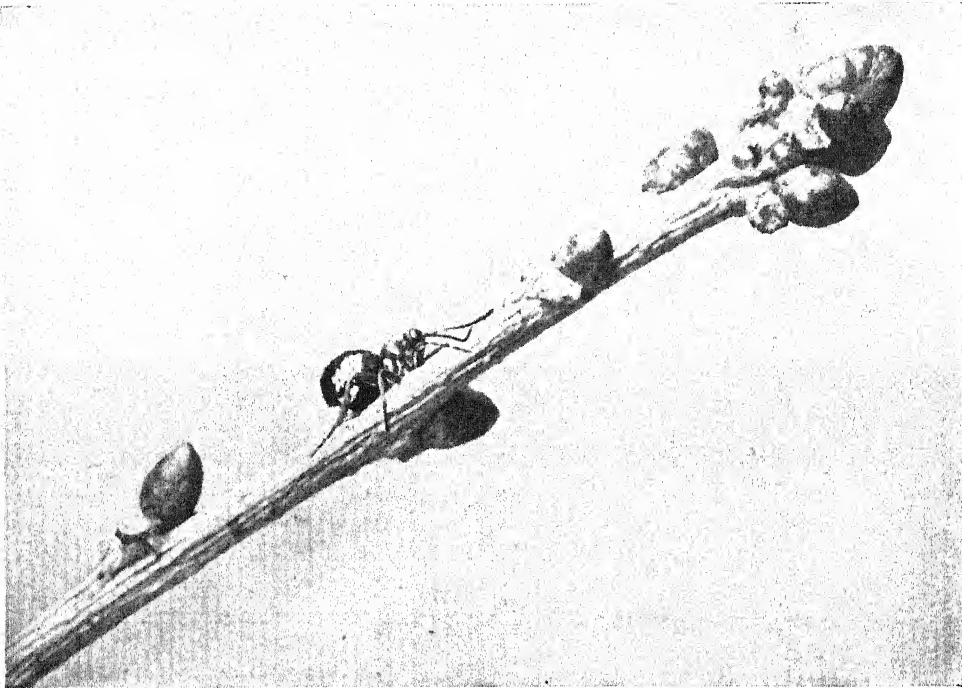
Everybody knows the oak apple, or "King Charlie's apple," which is sported as a buttonhole by country lads on "shig-shag" day. Yet it will probably come as a surprise to many to be told that these pretty, fruit-like objects are really the nurseries of certain minute four-winged flies related distantly to our bees and wasps. Such, however, is the fact; and to prove it one need only keep an oak apple, which has become "ripe" and brown, for a few weeks beneath an inverted tumbler. In due course the flies will make their appearance, burrowing through the substance of the gall.

To trace the complete life cycle of the oak apple gall insects, however, it will be necessary for us to begin by carrying our minds back to the dull, cold days of mid-winter. For strange to say, and contrary

to the common custom of insect life, the insect which originates the oak apple is abroad and active about Christmas time. By patient search she may be found creeping upward upon the twigs of oak trees. In appearance she is not unlike a small ant. She has no wings, and

able to thrust her egg tube right down among the tightly packed baby leaves which lie snugly waiting for the call of the springtime to rouse them from their slumbers.

What follows is soon told. Down her long ovipositor the fly passes her eggs,



AGAMIC FEMALE OF OAK APPLE INSECT

Ascending oak twig to oviposit in terminal bud.

must thus accomplish all her journeyings afoot.

Let us follow in imagination the doings of this intrepid insect. She makes her way to one of the buds of the oak tree—usually selecting a terminal bud—and climbs upon it. She is equipped with a long ovipositor, or egg tube; and by means of this instrument she is about to anticipate the course of the springtime which she is destined never to know. Cleverly she inserts her ovipositor between the closely wrapped bud scales. She is too wise to attempt the futile task of boring through the substance of the scales themselves; but by searching out a weak spot in the armour of the bud, at a point where the scales overlap, she is

one by one, and thus lays them without difficulty right within the bud, at the base of the young leaves. When she has inserted as many eggs as she deems the bud will support, she withdraws her ovipositor, and crawls to another bud. This she also inoculates; and so on, until her store of eggs is exhausted. Finally, her labours over, she dies, having performed the office by virtue of which she holds a place in the economy of Nature.

I need hardly say that to discover one of these inoculated oak buds is by no means an easy matter. The task may almost be likened to the search for the proverbial needle in a haystack! But by dint of perseverance—carefully splitting one terminal oak bud after another, and

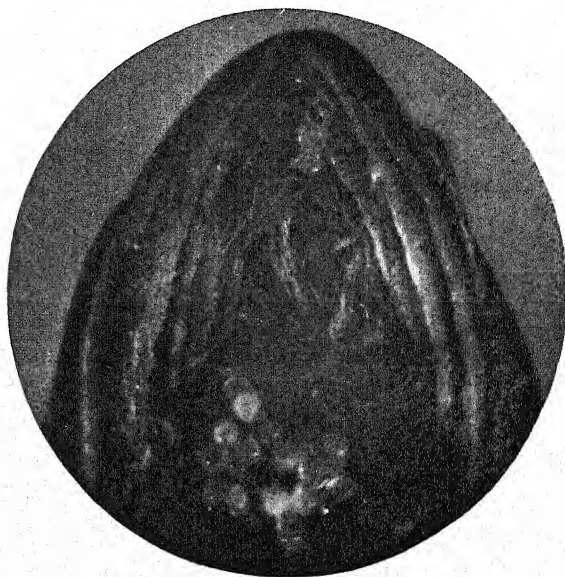
examining the contents of each with a magnifying glass—I had the good fortune to discover a mass of the transparent, pear-shaped eggs of the fly in one of them. The photograph of this bud, with the eggs *in situ*, appears on this page. It has not been touched up in any way; thus the reader may see for himself that the gall-fly really lays her eggs right down in the heart of the bud.

Now all these buds which contain eggs bring forth oak apples in the springtime; and within these oak apples the young grubs that hatch from the eggs are nourished upon the sap which, strictly speaking, is provided by the tree for the development of its leaves. But how is this thing brought about? In what manner does the gall insect contrive to make the tree provide food and shelter for its offspring? These questions have puzzled naturalists almost as long as naturalists have existed to be puzzled. Pliny thought that galls were fungi, and that the flies were bred in them by chance. A later author said that the parent insect laid its eggs in the ground, whence they were drawn up by the sap to the leaves where the galls were found. Still another writer put forward the rather obscure theory that "the plant had a vegetable soul, this vegetable soul presiding at the origin of galls, with their eggs, larvæ and imagines, while it again gave issue to fruits." A more modern notion, and one which until recently received universal acceptance, was that the parent insect infected the plant tissue during egg-laying—injecting a minute drop of peculiarly poisonous fluid, and that this poison caused the rapid enlargement and subdivision of the vegetable cells affected by it, so as to form the tissue of a gall.

Without going into detail, it may be said that this theory—despite its plausibility—does not correctly solve the problem of gall formation. Scientific observers have found that although the gall wasps actually inject a drop of fluid into the wound which they make in the buds, they do this either to provide a

lubricant for the working of their ovipositor, or as a varnish to seal up the injury—certainly not to poison the tissue.

How, then, are we to account for the formation of galls? Probably the irritation set up by the presence of the eggs, and subsequently by the gnawing of the tiny grubs, is the sole cause. It may be urged that the presence of eggs, or the gnawing of microscopic grubs, seems an insufficient reason to account for the production of an elaborate gall formation.

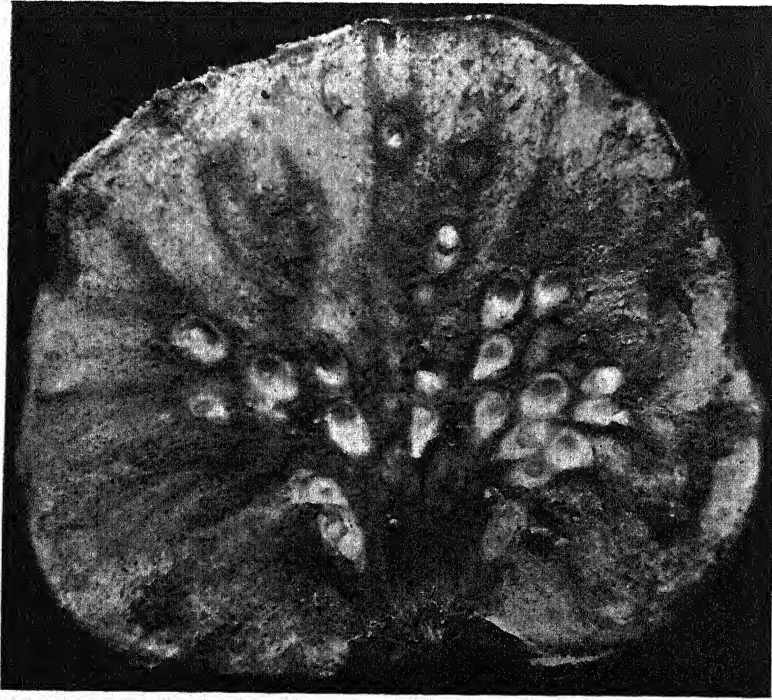


MAGNIFIED SECTION THROUGH TERMINAL
BUD OF OAK.

Showing eggs in lower part laid by wingless female of oak apple gall-fly

But the eggs are invariably laid in contact with what botanists term meristem tissue—that is to say, the particular layer of vigorous cells whose active multiplication by fission brings about the phenomenon which we call "the growth of the plant." These cells are known to possess an extraordinary sensitiveness, and it is not, therefore, unreasonable to suppose that an irritant, however slight, would divert the energy that in normal circumstances would assist in building up the leaf tissue.

Truly a marvellous phase of Nature—that these minute insects should be gifted with the power of diverting to their own uses the cell energy of plants and trees! Moreover, there is further cause for wonder in the fact that each of the many kinds of



SECTION THROUGH AN OAK APPLE (ENLARGED).

Showing chambers wherein the grubs undergo transformation.

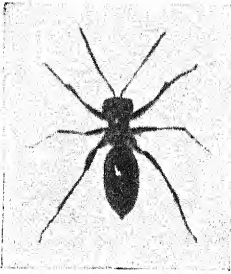
gall-flies known to science is bred from a perfectly distinct and characteristic gall. These galls all originate in exactly the same manner; *i.e.* in the egg-laying of an insect. The reason why they differ so markedly has yet to be discovered. Yet I believe that when this difficult question is cleared up, we shall find that whereas the plant makes the gall in so far as the supply of constructive energy is concerned, the tiny grub (or, in certain cases, the development and swelling of the egg), by irritating the sensitive cells in a peculiar way, determines the form which the gall shall take. In other words, each kind of gall-grub probably gnaws the cells in a manner quite different from that adopted by all other kinds of gall-grubs, just as the caterpillars of butterflies and moths have characteristic methods of feeding upon leaves.

Let us now return to our oak apple. As the spring advances, the little colony of grubs within, each in its separate cell, feeds and grows fat. When full

fed, each grub changes to a pupa, and towards the end of June emerges from the gall as a perfect fly. Now these flies differ markedly from their parent — the ant-like insect which laid her eggs in the oak bud. They are inferior to her in size, while each has four wings. Moreover, this generation of the oak apple gall-fly comprises

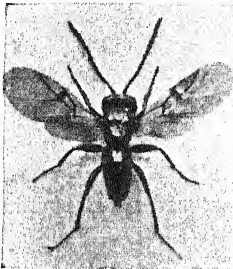


OAK APPLE IN EARLY SUMMER.



THE WINGLESS FEMALE
(FIRST GENERATION).

Which oviposits in the terminal buds of the oak in winter.
(Magnified.)



OFFSPRING OF THE
ABOVE.

One of the winged, sexual generation of flies, which comes from the oak apple in summer-time. They lay eggs in the rootlets of oak trees, and their eggs produce agamic, wingless females.
(Magnified.)

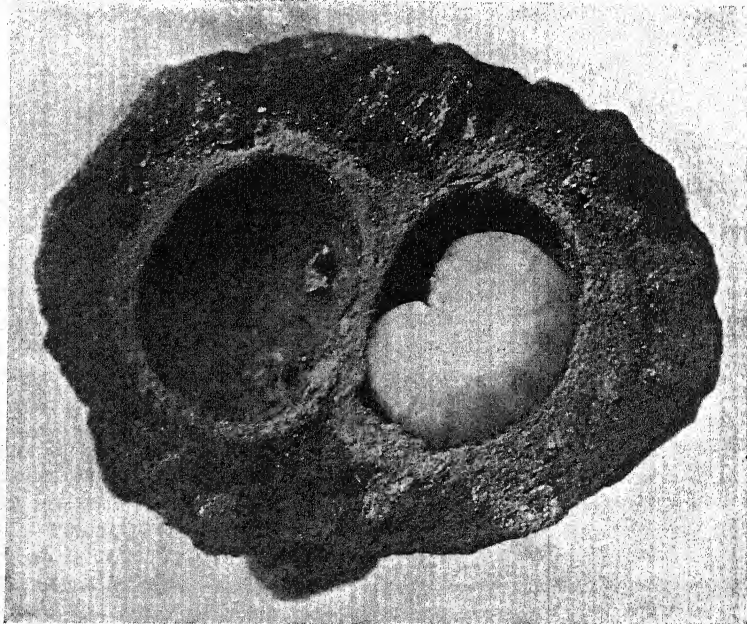
the tender rootlets of the oak. As a result, galls are produced upon the rootlets; and in them the winter generation of wingless females comes to maturity. These root galls, by the way, are much smaller and harder than the oak apples. Indeed, they are not unlike little nuts, or stones, and those who

both males and females, whereas the wingless winter generation consists entirely of females endowed with the mysterious power of parthenogenesis, or virgin reproduction. Also, the females of the winged summer brood behave in quite a different manner from that adopted by their forerunners, the larger wingless females. Instead of ovipositing in oak buds, they work their way beneath the shallow soil and lay their eggs within

wish to find them must search with care. Each root gall, too, has only a few inmates (perhaps only one or two), whereas the oak apple generally contains several scores of grubs.

Let me now briefly summarise the life cycle of the oak apple gall-fly, in order that we may realise how markedly it differs from the life cycles of insects in general. In the first place we saw a tiny insect abroad in the dead of winter, laying her eggs at the heart of an oak bud. As spring advanced, this bud developed into an oak apple gall, which provided food and shelter for a number of grubs. In June these grubs completed their transformation within the gall, and came forth as perfect flies, differing in an extraordinary manner from their parent.

Now, in the case of an ordinary insect, the story would end here. To continue our observations would be merely to verify facts which we had already noted. Not so, however, with the gall-flies. We saw that the egg-laying of the second generation of flies resulted in galls quite different from the oak apple, and that from these galls came wingless female

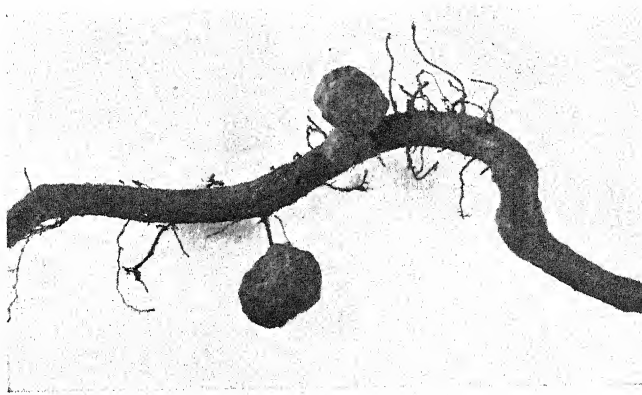


SECTION THROUGH GALL FROM ROOTLET OF AN OAK
(GREATLY ENLARGED).

Showing chambers, one of which contains a grub.

flies, capable of virgin reproduction, such as the one with which we commenced our story. And so this wonderful alternation

to say, a phenomenon so remarkable has attracted the attention of men of science, and given rise to much discussion and



GALLS ON ROOTLET OF OAK.

Wherein are reared the agamic generation of the oak apple gall-flies.
(About natural size.)

of generation—this interchange of personality—continues year after year, in apparent defiance of our trite dictum that like invariably produces like. Needless

theorising. So far, however, no adequate explanation of the facts seems to be forthcoming.

HAROLD BASTIN.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.

With Photographs by HENRY IRVING

THE FLOWERS OF THE HEDGEROWS

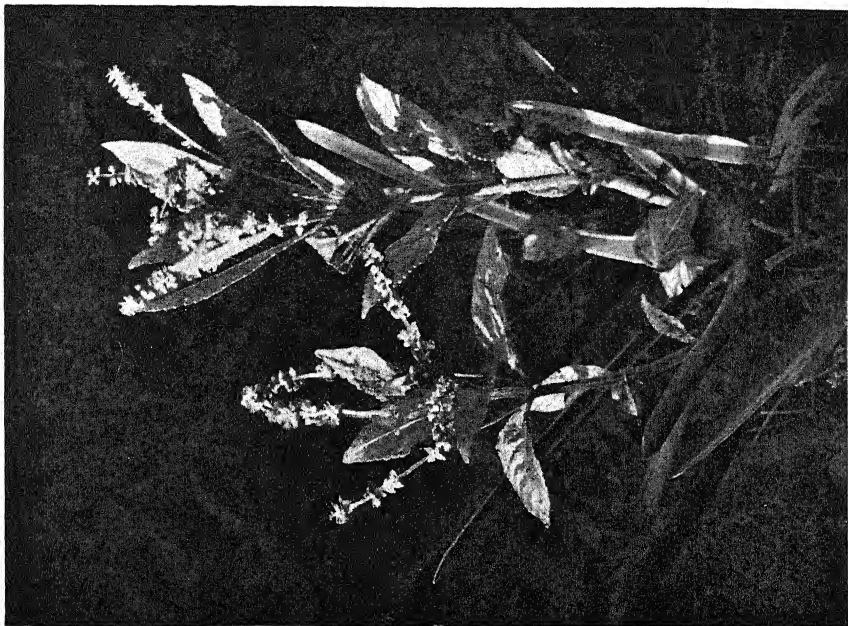
THE WILD ARUM

THE Cuckoo-pint, or Lords and Ladies (*Arum maculatum*), appears in the hedgerows in April, and, from its curious shape and its dissimilarity to other plants, it is an object that attracts notice readily; it is the only representative of the *Araceæ* that grows in this country.

The leaves are generally to be found in March—shiny, bright green leaves—often marked with black or purple blotches, spear-shaped at the base, and each one with a long stalk coming straight up from

the root; the latter will be found to be a white tuber, with a very bitter taste.

The flower stalk is contained inside the curious-looking leafy shelter, called the spathe; if this is carefully pulled away the actual reproductive portions will be exposed—the club-shaped portion at the top is either purple or yellow, making the distinction between the “lord” and “lady.” Just below the point where the leafy cowl is folded will be seen a ring of hairs pointing downward, beneath which are the stamens or male flowers, while at the base are the pistils (female flowers), and



DOG'S MERCURY.



WILD ARUM



WHITE VIOLET.

all these are arranged on and round the curious purple or yellow spike.

The pistils mature before the pollen is set free from the stamens, and each one

secretes a drop of honey; attracted by this, flies, and other small insects, creep down easily enough through the fringe of hairs, but these, being arranged



GROUND IVY.

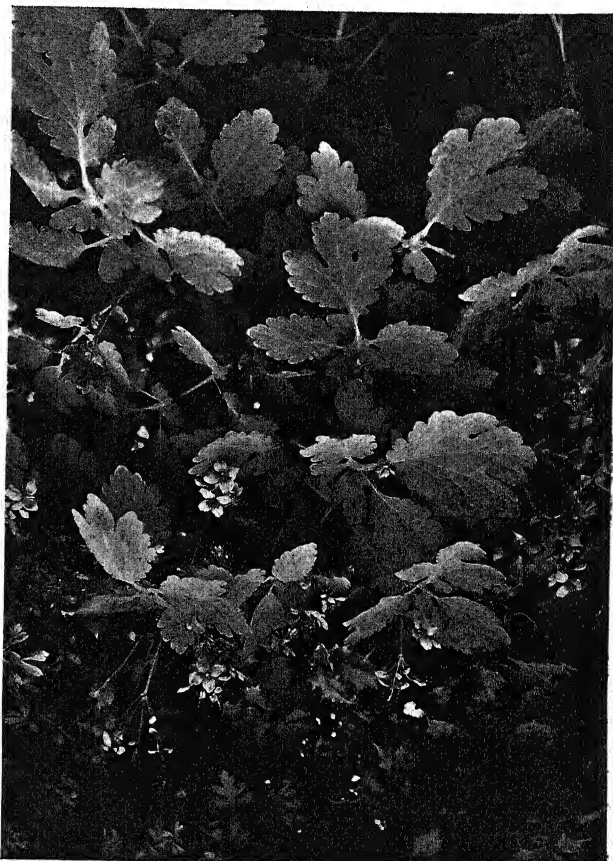
on the principle of the lobster-pot, prevent them crawling out again for the time being. After a while, the pistils begin to wither, and then the stamens mature and shower the pollen over the visitors; the fringe of hairs shrivel up and allow the flies to escape. Since they are well provided with honey, the fact of their being in captivity does not appear to worry them, for when they are liberated they seem quite willing to visit another Cuckoo-pint flower, and if this occurs when the pistils are maturing, they are sure to leave some of the pollen they have brought with them on the sensitive stigmatic surfaces, and in this way effect cross fertilisation. It is an ingenious device, and makes one wonder how many stages these plants have been through, and how many thousands of years it has taken to bring them to this pitch of perfection.

In the autumn, the seed vessels will be seen occupying the place of the pistils—bright red berries, looking like bunches of coral; they are very bitter to the taste and are also very poisonous.

THE VIOLET

This flower needs no introduction for the purpose of identification, but there are a few facts which are worthy of mention. The flowers of both the Sweet Violet (*Viola odorata*) and the Dog Violet (*Viola canina*) are very similar in structure, but the latter, however, is devoid of scent; the green sepals are somewhat different, for in the Sweet Violet they are blunt, while in the other they end in sharp points. Both of these plants (as in the case of the Wood Sorrel) bear two kinds of flowers. Besides the well-known coloured blossoms, a little later in the year there will be found, hidden among the leaves, other smaller, and greenish, flowers with practically no petals. These bear much more seed

than the showy ones, and it would seem to be a waste of energy on the part of the plant to produce its coloured blooms at all; probably the reason is that cross fertilisation takes place in these latter blossoms, and thus a cross is occasion-



GREATER CELANDINE.

ally secured. The White Violet, which is frequently found nestling in the banks under hedges, is a variety of the scented kind; the Dog Violet is generally of a paler tint than *V. odorata*. If one of the flowers be pulled to pieces carefully, it will be noticed that the five petals are irregular in shape, and that one of them is lengthened so as to form a covering for the spurs of two out of the five stamens; it is inside these two spurs that the honey is secreted. The free ends of the stamens have small membranous expansions which overlap and form a ring round the pistil;



WHITE DEAD-NETTLE.

this arrangement provides a hollow space into which the pollen falls. When a bee visits the flower, its head comes in contact with the pistil, and moves it, so that the pollen falls down on to the bee's head, and on its visit to the next flower is brought on to the stigma.

The Violet pollen is much drier than that of most flowers, so that it readily falls from the anthers into the hollow space referred to.

DOG'S MERCURY

The Dog's Mercury (*Mercurialis perennis*) is to be found abundantly everywhere. It flowers in the early spring, and the blossoms appear before the leaves are fully expanded. It is not a herb that attracts very much attention or admiration; the whole plant, flowers and all, is green, and grows about a foot high.

The male and female blooms are borne on different plants, thus entirely preventing self-fertilisation, and the male flowers are arranged in little clusters, but the females singly or, at the most, two together. One of the most interesting points to be noticed is the manner in which the leaf bud is protected; the young stems are bent over so that they can readily push their way through dead leaves, moss, and other such obstacles, and each leaf is rolled inwards in such a way that the rough midrib is uppermost and protects the delicate green tissue.

The name Mercury is derived from the god of that name and refers to the poisonous properties of the plant, whilst the prefix "Dog's" is a term applied to worthlessness.

THE GREATER CELANDINE

The Greater Celandine (*Chelidonium majus*) has already been mentioned (p. 17) as being quite distinct from the Lesser Celandine (*Ranunculus ficaria*), and if the two plants are put side by side it will be readily seen that they are very dissimilar except in name. The Greater Celandine begins to flower about May and continues, more or less, throughout the summer; the fact that it has two sepals and four petals proclaim it to be one of the Poppy family. The stem grows sometimes as much as two feet in height, and secretes a very acrid, poisonous, yellow juice, which, at one time, was used for various medical purposes; the leaves are light green on the upper surface, and bluish green beneath. The photograph shows clearly how the leaves are divided up into segments. The flowers are small and bright yellow, and from three to six of them are arranged on short stalks, which all spring from the same point.

The name Celandine comes from the Greek *Chelidon*, a swallow, and it may be that both the plants of this name were so called because they come into flower about the same time that the swallows appear. But Pliny and Aristotle have a different story; they relate that the juices of the plant were used by the swallows to restore sight to the young ones when their eyes had been put out.

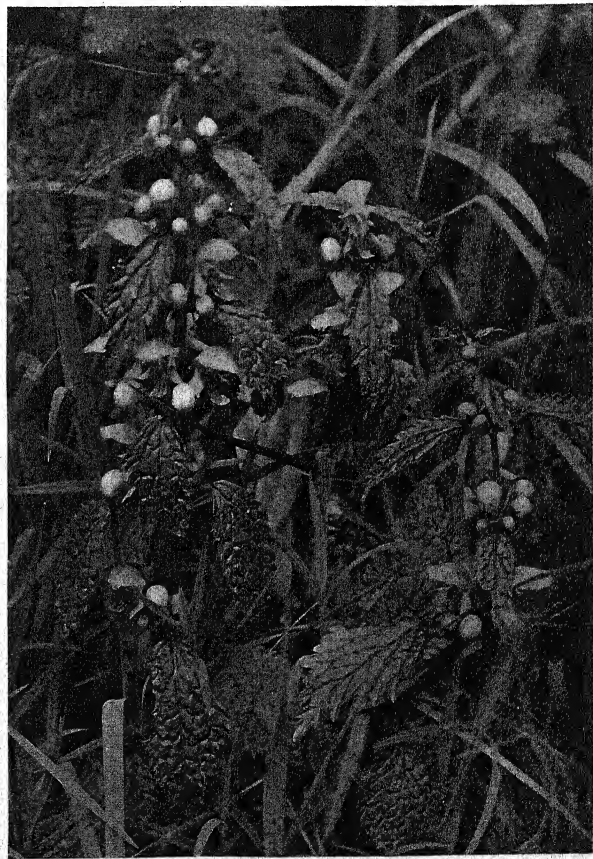
GROUND IVY

The little herb that is commonly called Ground Ivy (*Nepeta glechoma*) is no relation of (and indeed bears no resemblance to) the common Ivy, and why it should have been so named it is hard to imagine. It is one of the somewhat large family of *Labiata*, or lipped plants, so called from the irregular shape of the flower, and well represented by the Dead-Nettles. The petals are united to form a tube, and the outer extremity of this is divided so as to make two lips. The plant trails along the ground, sending out root fibres at intervals, and upright flowering stems from six to eight inches high; the leaves are circular with kidney-shaped divisions at the base, the lower leaves being larger and on longer stalks than the upper ones. The purple flowers are borne in semicircular clusters round the stem, and the plant, when bruised, gives out an aromatic smell. Most of the flowers will be found to bear both stamens and pistils, but on looking over the plants carefully, smaller flowers will frequently be found bearing pistils only; in the case of the former the stamens shed their pollen and wither away before the pistils waken, in order to prevent self-fertilisation. The Ground Ivy, at one time, was used for making beer, whence come the old local names, "Ale-hoof," "Tun-hoof," and "Gill-go-by-ground"; a decoction of it was also used as a cure for consumption. It blooms from

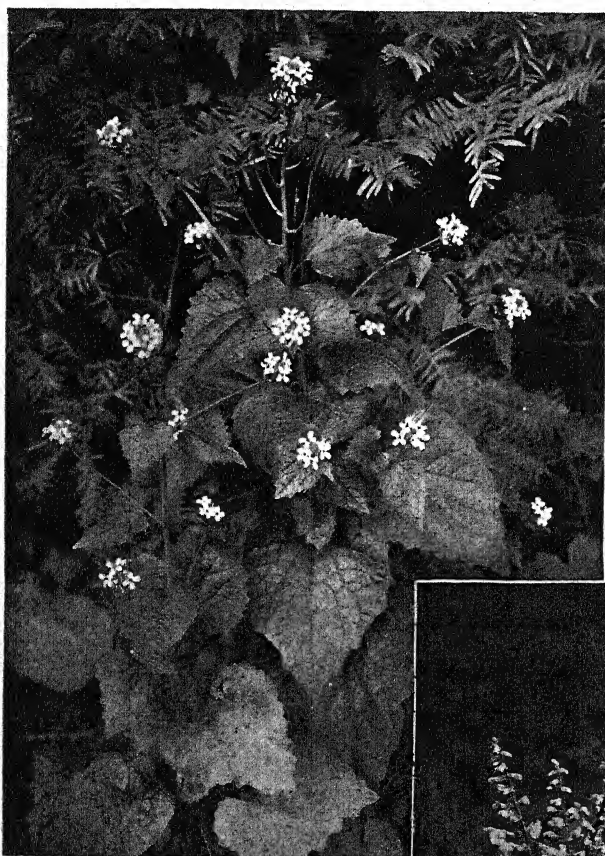
March well on into the summer, and is abundant in nearly all hedgerows and waste places.

WHITE DEAD-NETTLE

The White Dead-Nettle (*Lamium album*) is a well-known plant, the leaves of which resemble those of the Stinging Nettle, and probably gain some immunity in so doing, for protective resemblance is not confined to the animal world. The shape of the flower will at once show it to be one of the *Labiata*. There is a supply of honey secreted at the base of the tube, which is well protected from the wet by the arching upper lip, and also from the ravages of small, undesirable insects by a fringe of hairs; the flower is adapted especially for humble bees, whose proboscis is long enough to reach the honey. Examine a flower carefully and notice the



YELLOW NETTLE.



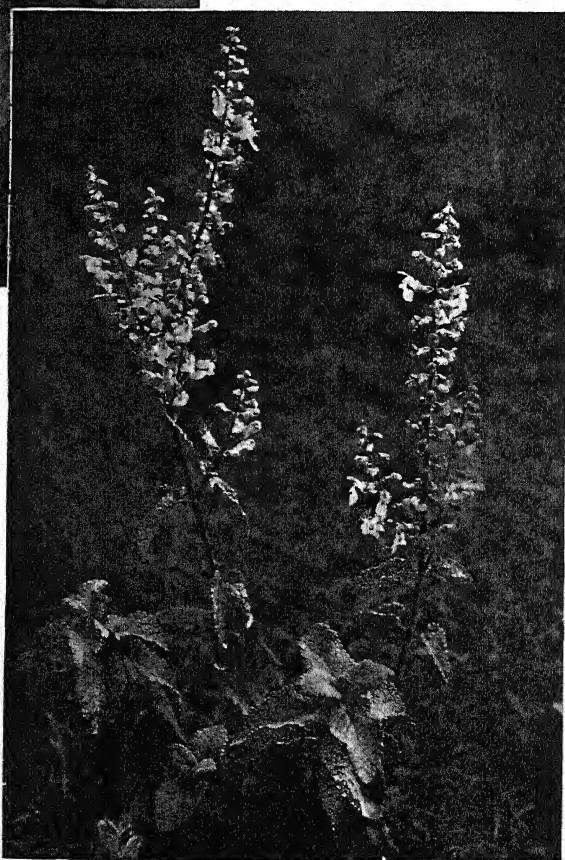
GARLIC MUSTARD.

two pairs of stamens, one short and one long, and the stigma hanging down below them. When a bee alights on the lip, it comes in contact with the stigma before it touches the anthers, so that any pollen it has brought along from another flower is rubbed off before it takes a fresh supply. The leaves are arranged in pairs, and the flowers in a circle round the stem, there being from six to twelve of these in a cluster. When the plant is bruised, a rather disagreeable odour is given off.

THE YELLOW DEAD-NETTLE

The Yellow Dead-Nettle (*Galeobdolon luteum*) is not so com-

mon as the white one, but in general appearance and shape the two resemble one another very closely; but the flowers of this plant are bright yellow, and the lip is spotted with a darker colour; it is to be found in flower from April to June. The common name of "Weasel-snout" is given to it on account of a fancied resemblance of part of the flower to the nose of a weasel. The Red Dead-Nettle (*Lamium purpureum*) is also found very commonly in the hedgerows and as a garden weed. All these Dead-Nettles bear the name of "Archangel," but why



WOOD SAGE.

BIRD LIFE

TYPES OF BIRDS—II.

Swimmers

The swimmers are local in their distribution, and the most typical specimen for study is the Duck. The Moorhen is a fairly common wild type. The important points are: (a) Short and strong legs; (b) webbed feet; (c) bills adapted for feeding in water.

The nests of these birds are generally rudely made, yet they are securely placed in rushes.

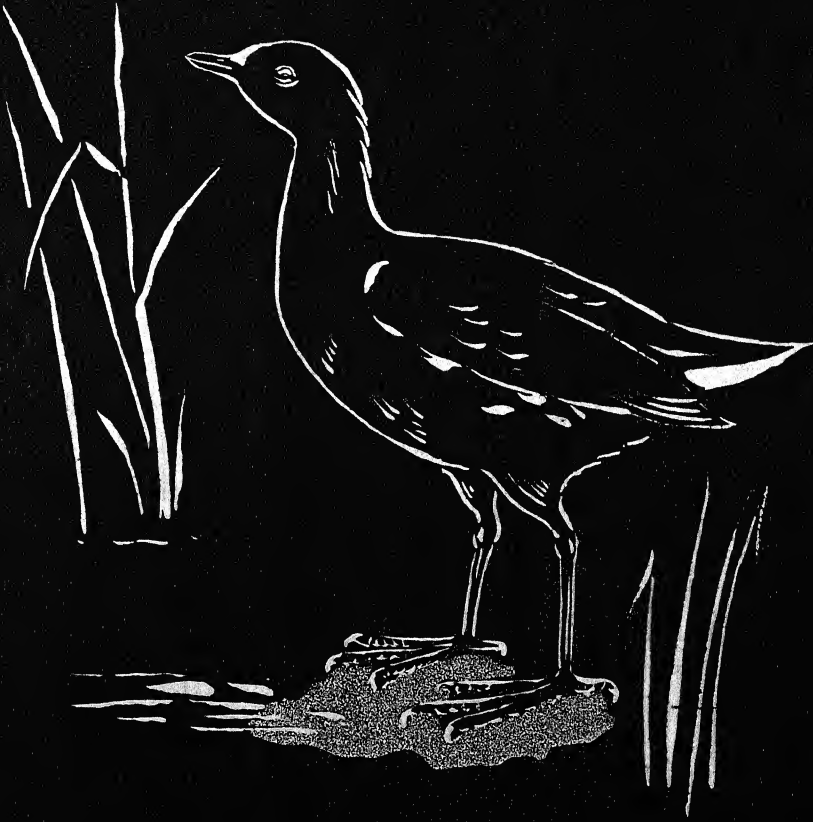
Scrapers

This class of birds is well illustrated by the Chicken. They usually possess sharp, strong claws, and their food is mostly of a vegetable nature. Their nests do not indicate any great care, and are usually placed on the ground. The Pheasant and Pigeon are members of this class.

Waders

The waders are mostly confined to the marshes except during severe weather, when they are driven inland for food. The Heron is a useful type—*viz.* it possesses lengthy legs and neck. The Lapwing, although its outward appearance does not indicate that it is a wader, is a most interesting bird, and may be observed in most districts throughout this country.

BIRD TYPES.



SWIMMER

MOORHEN



PHEASANT

SCRAPER (GALLINAE)

they were so called it is hard to say, unless it was because they were all to be found in flower about May 8th, the Archangel St. Michael's day.

WOOD SAGE

Another representative of the *Labiatae* is the Wood Sage, or Wood Germander (*Teucrium Scorodonia*), which is found abundantly, and flowers throughout most of the summer and autumn.

The pale yellow flowers are in pairs, with a tiny leaf (bract) at the base of each little flower stalk; the calyx has one broad and four narrow teeth. The stamens ripen first, and then curl backwards out of the way, allowing the pistil to move forward, so as to come in contact with any visiting insect which is bringing pollen from a less mature flower.

GARLIC MUSTARD

A tall growing plant with shiny leaves and small, white flowers, blooming in the spring, will probably be the Garlic Mustard, or "Jack-in-the-hedge" (*Alliaria officinalis*). Examine one of the flowers and notice the four separate petals arranged in the form of a cross, the four sepals, and the six stamens, two of which are shorter than the others; these points are common to all the family of *Cruciferae*. The lower leaves have longer stalks than those higher up the stem, and the latter are more definitely triangular in shape and more regularly toothed. The plant may very easily be recognised by its strong scent of garlic when any portion of it is bruised, which accounts for the two common names, Garlic Mustard or Hedge Garlic.

H. PUREFOY FITZGERALD.

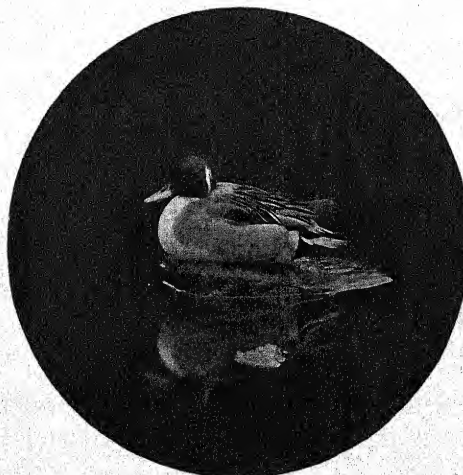
HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE SWIMMERS—II

THE ducks may be divided into surface feeders and divers, although all ducks are, at a push, expert divers. As is the case with the Mallard, all the commoner species differ very much in sexual plumage, with the exception of the Black Duck, or Scoter. Although the distinctive differences of adult males in the various species are easily discernible, the female of one kind may approximate very closely to the female of another species. Such is the

case with the female Wild Duck and the female Pintail, but the latter is of a lighter brown body colour and slightly smaller. The neck is longer in proportion and more slender, and the two centre tail feathers are slightly elongated. The speculum, or wing spot, is dark green shot with copper, and not purple shot with green, as in the Wild Duck and Mallard. There can be no possible difficulty in differentiating between the drakes of the two species. The Mallard's blue-green



Photograph by F. Atkinson, Leeds.
PINTAIL.

head, white neck-ring, beautifully vermiculated flanks, curly black feathers above the tail, and orange feet and legs, are unmistakable, and are too well known to be confounded with the brown head and wide white neck stripe of the long-tailed male

The female Wigeon, though smaller still than the Shoveller, is somewhat like the Wild Duck, but the back is nearly a whole-coloured brown, and the breast and belly nearly white. In shape and colour the female Teal, the smallest of all our



MALLARD ON NEST.

Photograph by J. T. Newman, Berkhamstead.

Pintail. The latter is a comparatively rare bird, but is not to be confounded with the rarer true Longtail, which is a sea-duck, and much smaller. The female Shoveller, too, does not differ much at first sight from the Wild Duck, except in its smaller size and the spatulate extension of the beak. The sides of the beak, too, are furnished with much more highly developed fringes of slender *lamellæ*; those on the upper mandible fit into those situated on the lower part of the beak, and thus make an excellent strainer for sifting out minute forms of animal life from the surface of the water in which the Shoveller delights to bibble. Whilst on the wing, the adult male shows much white on the shoulders and under parts.

ducks, approximates more nearly to the female of the Mallard.

The Shoveller is not at all a loquacious bird, but the "tharp" of the Mallard, "quack" of Wild Duck, "crick" of Teal, and "wheoh" of Wigeon, are well-known sounds to all flight-shooters, whilst the most proficient of marsh gunners will identify all the commoner species of duck in the dark by their various wing sounds, and even by the specific splash which they make on rising from the water. Generally speaking, all ducks feed chiefly at night, and rest by day, except, of course, when frost compels a change of custom.

The male Wigeon carries a cream-coloured crest. In fact, in full plumage



POCHARD.

Photograph by J. Atkinson, Leeds.

the whole head is creamy chestnut, the throat is black and chocolate below, and the upper surface of the body delicately vermiculated with grey and black. The male Teal is also similarly coloured above, but the head and neck of deep chestnut with broad green stripe outlined with white, extending from around the eye down the sides of the neck, is a distinctive characteristic of the most beautiful and tamest of British wildfowl.

Wild Duck, probably on account of the increased artificial rearing of these birds for sporting purposes, are on the increase, and for some unaccountable reason Shovellers also have of recent years bred more frequently in several counties; but, on the other hand, for an equally inexplicable reason Teal do not so often stay to rear their young here as was the case five-and-twenty years ago.

Coming to the diving ducks, the Pochard or Dunbird—so-called from the colour of the head, which is dark dull brown in the female and chestnut-red in the male—is

the most common. It occurs in large flocks during the winter months—resting by day at sea generally, and coming to feed on inland waters at night. But on the Broads, reservoirs, and large undisturbed pieces of shallow and weedy water, where food is plentiful, Pochards frequently spend both night and day. In favourable localities a few pairs remain to breed. The speculum, or wing patch, in this duck is grey and indistinct, and the beak black with a lead-coloured band across the middle. The crimson iris of the adult male is also a distinguishing but an unreliable feature, as it is not assumed until about the end of the year, and frequently fades to yellow after death. I have, in fact, watched the process in a wounded bird.

Of the three black and white ducks the Tufted, or Black-headed Pouter, is the most common, and seems to be on

*Photograph by J. Atkinson, Leeds*

SHOVELLERS: DUCK AND DRAKE.



WIGEON.

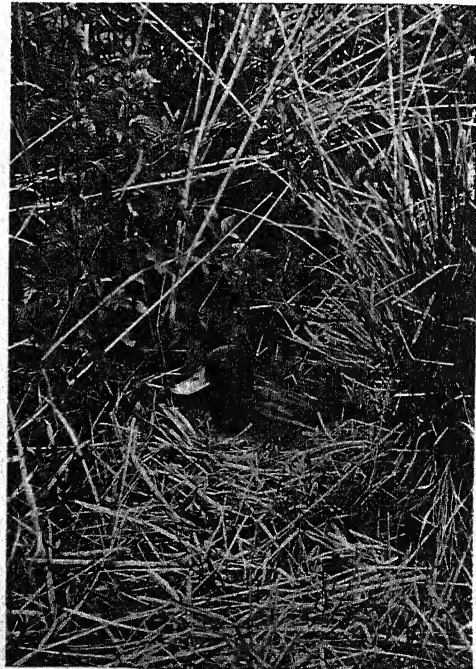
Photograph by J. Atkinson, Leeds.

the increase as a breeding species. In both sexes the head tuft is unmistakable: in old males the elongated feathers extend an inch or two beyond the nape; in the females they are not so apparent, and the black is not nearly so intense. In both sexes of the Golden Eye the feathers on the nape and upper neck are thick and narrowed at the back, but there is no real tuft or plume. The beak and feet of the Tufted Duck are slate colour, the under parts and wing patch white. The male Golden Eye in full plumage has a large white spot on the face, and the female Tufted Duck has sometimes a small and indistinct patch of white between the eye and the beak; but the female Scaup always possesses a broad white band at the base of the beak. The young male Scaup shows this less distinctly; the adult males have the head, neck, and upper part of the breast a lovely glossy green black; the beak is broad—about as long as the head and slightly tilted upwards—and in colour dull grey with a black nail. The feet and legs are lead colour, whilst in the Golden Eye they are yellow, mottled with black in the young. Both are winter visitors, and their presence often presages hard weather.

I have heard it said by those who knew him well that the late Mr. E. T. Booth, of

Brighton Museum fame, could identify most of our birds by handling them behind his back; and in the case of the Golden Eye—the most expert of our diving ducks—the largely developed hind toe would be the first thing to be felt for. It is marvellous to watch these restless birds constantly diving for food in a “wake” (the local name

for an open space in the midst of an otherwise frozen sheet of water); they never seem to make a mistake by coming up under the adjacent ice, however small the diameter of the “wake” may



Photograph by Wm. Farren, Cambridge.
TUFTED DUCK.

be. In flight their rapidly vibrating pinions make a peculiar noise which has won for them the alternate name of Rattlewings.

All the diving ducks have the legs placed far back, their generally smaller bodies are rounder and more thickly clad with down, their wings are comparatively shorter and more curved, and their flight is more hurried and irregular than that of the surface feeders. They never wheel about in the air with graceful ease, or for mere enjoyment—as, for example, Teal apparently do; and when alighting on the water they cut the surface with a long, sliding splash, whereas the surface feeders, with outstretched wings and feet,

face the wind and gently sit afloat as soon as the body touches the water line.

The moulting season is a trying time for ducks. The Mallard, for instance, sheds nearly all his pinion feathers simultaneously, and is consequently incapable of flight for some few weeks together, and thereby exposed to many dangers. Nature, however, steps in to render him less conspicuous than he would be were his gaudy courting dress retained. Instead thereof he is meantime clothed in what is aptly termed an “eclipse plumage,” wherein he closely simulates his spouse’s feathering, and thus soberly attired is better fitted to escape the observation of his foes.

MAURICE C. H. BIRD.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

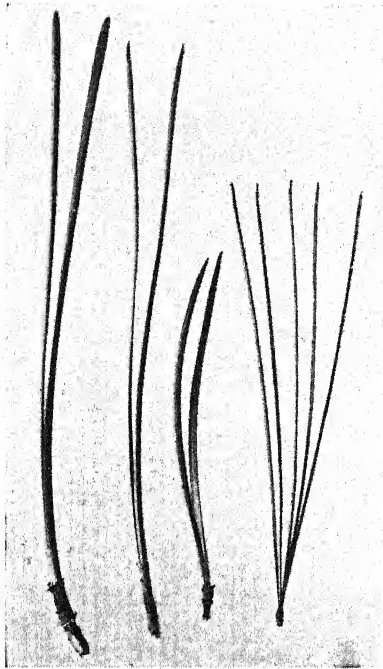
THE CONIFERS—FIRS AND PINES

THE trees included under the general title Conifers form a very large and important class. Their character is so distinctive that they stand apart from all others.

Nearly all of them are evergreen, their leaves remaining attached for a series of years. A notable exception is the Larch. The nature of these long-persisting leaves has undergone special modification with a view to their endurance through extreme variations of temperature and climate. As a consequence of this modification these trees can live and thrive in exposed situations, braving the winds, unharmed by the snow, where other trees would suffer rending and maiming. In texture these leaves are hard and leathery; in shape they are long and very narrow, exposing but the smallest surface, re-

ducing transpiration to a minimum, offering least resistance to the wind. The little surface that is exposed is smooth and shiny, and from it the snow slips off before its accumulation becomes a peril.

Their flowers are crowded together, in the shape of spikes or cones, which again may be grouped into clusters; but each cluster comprises one kind of flower only, which is either pollen-bearing or fruit-producing. These are generally found on the same tree. The quantity of pollen thrown off is enormous, floating away in clouds, settling and forming drifts in places, giving rise to the frequent country legend of a sulphur shower. Conifers rely upon the wind alone for the conveyance of the pollen, and the abundance of this is a precaution against failure.



NEEDLES OF CLUSTER, AUSTRIAN,
SCOTS, AND WEYMOUTH PINES.
(From left to right.)

Under the microscope each pollen grain is seen to possess two air bladders in aid of flight.

Their fruits are, with exceptions, the familiar woody cones. These are made up of hard scales spirally arranged round a central axis. These scales overlap like tiles, being further made secure by a resinous glue. Enclosed and protected by these the seeds mature, two in each scale-roofed chamber, till such time as they are fully ripe. Eventually the scales relax, in some instances gaping open, in others separating and falling, to set free the seeds, which, being winged, are wind borne and dispersed. But some Conifers, as the Yew and the Juniper, produce not cones but stone-fruits, having their seeds surrounded by or embedded in an edible pulp.

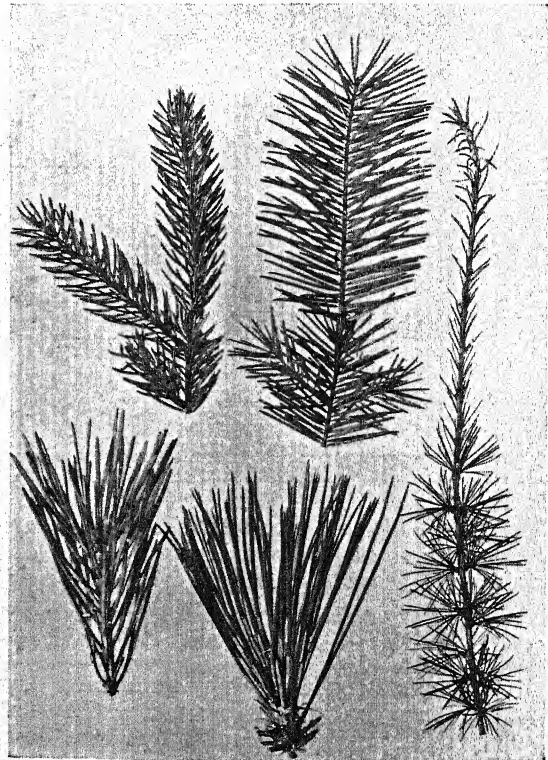
All the Conifers which will come under notice here, with the single exception of the Yew, belong to the Pine family. This includes the

Firs, with leaves single but crowded on the twigs; the Pines proper, with leaves in bundles of two, three, or five; the Larch and the Cedars, with leaves in tufts of twenty or more; the Cypressess, with leaves as close fitting scales.

THE FIRS

Those most commonly found are the Spruce, the Silver Fir, and the Douglas Fir. The shape of a Fir tree is pyramidal, having its branches arranged circularly and outspreading, at regular intervals up the main stem, longest below, shortening gradually upwards to the leading shoot, which makes the apex of the pyramid. Each unbranched interval on the main stem represents a year's growth.

In distinguishing between the Firs, and for comparison with the Pines, chief attention may be given to the leaves and the fruits. The leaves of the Firs, attached singly, and having the appearance



SHOOTS OF CONIFERS.

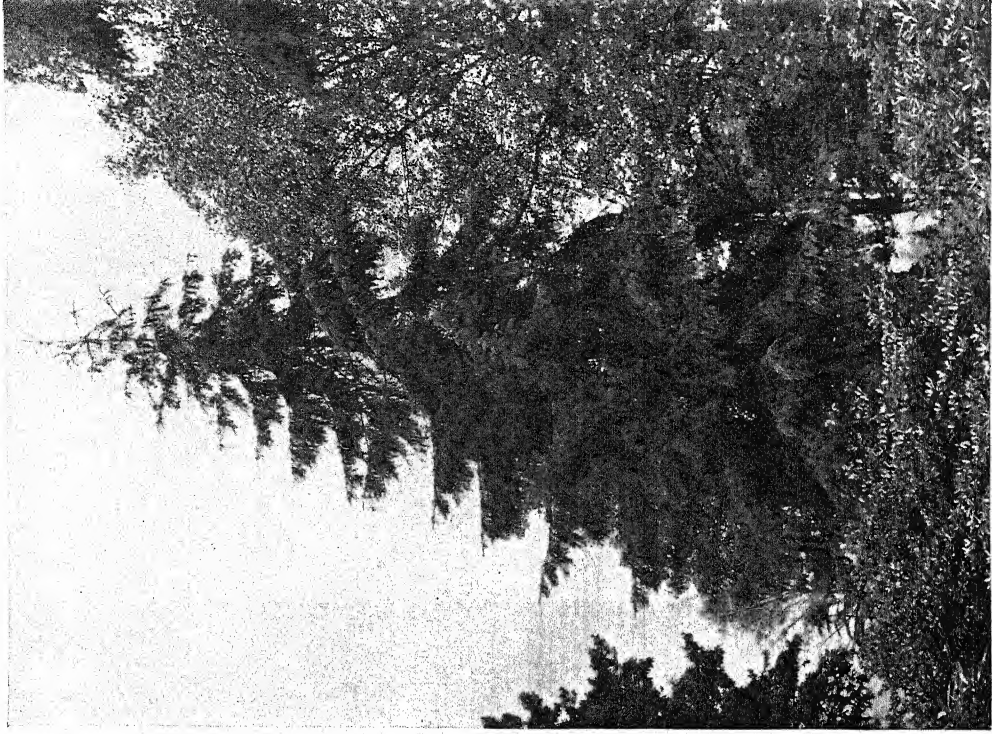
Spruce.
Scots Pine.

Douglas Fir.
Austrian Pine.

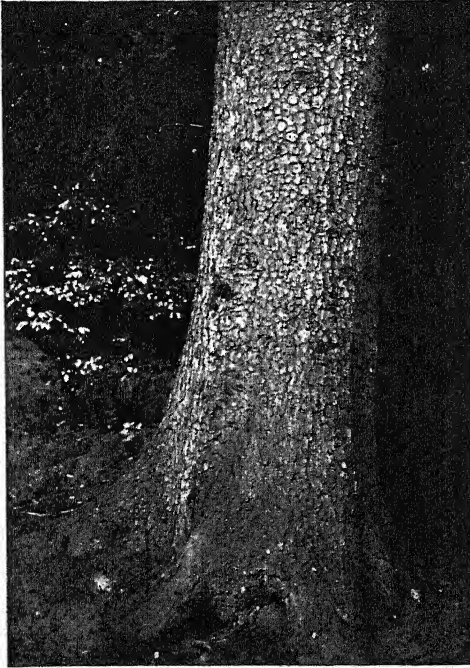
Larch.



SPRUCE.



DOUGLAS FIR.



TRUNK AND BARK OF SPRUCE.

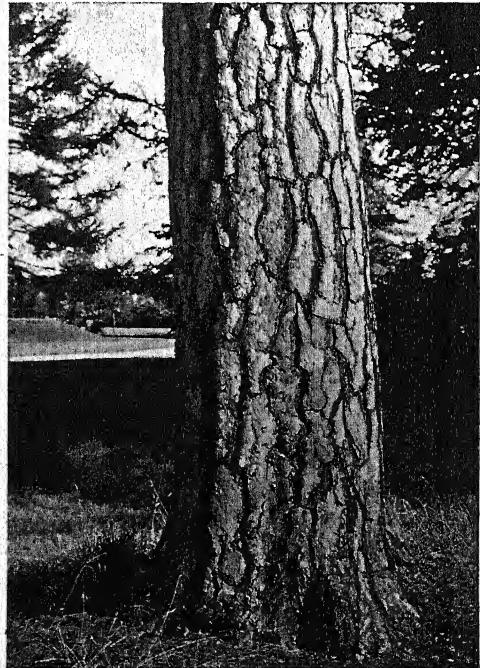
of short lengths of ribbon, are arranged in a close spiral, crowded together, but, as it were, combed out flat on either side of the twig, the object being to get the breathing surfaces underneath. The fruit cones of the Firs have scales of a uniform thickness, whilst those of the Pines show scales having either a central or terminal swelling.

The Spruce. The bark is reddish grey, and flakes off in thin rounded scales. The leaves are short, narrow and thick, nearly square in section. They appear as if stroked down on to the twig, rather than combed out laterally, and are of a dark uniform green. The glistening brown cones are spindle-shaped, and hang with their points downwards. They remain on the tree through the winter. Some time in the following summer the cone-scales gape apart, setting free the ripe winged seeds. Later the empty cones fall bodily.

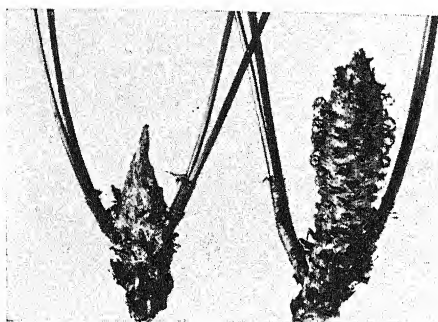
The Silver Fir. The tree becomes less distinctly pyramidal, its top grows bushy and eventually flattened. The bark is a lighter grey, its scales are less rounded, and there is the suggestion of fissures.

The leaves are longer, broader, and relatively thinner. Their under surface is marked along its whole length by a pair of shining silver lines. The leaves are more distinctly combed out. On the fruiting branches, which are always near the summit of the tree, they curve upwards, exposing freely their silvery undersides. The cones are cylindrical and stand erect. Their surface is roughened by spiny projections emerging from under the scales. When the fruit is ripe, in the autumn of the same year, the cone-scales loosen and fall, releasing the seeds. Only a bare central spike remains on the tree.

The Douglas Fir. The bark is thick, reddish brown in colour, and deeply furrowed. The leaves are more delicate in texture. On the horizontal twigs they are so flattened out on either side that they might have been subjected to pressure. They show two thin silvery lines on the under side. The cones are egg-shaped, of a light brown colour, and they hang downwards. Lying upon and projecting over each woody scale is a soft fibrous scale in the form of a trident, an



TRUNK AND BARK OF THE SCOTS PINE.



AUSTRIAN AND CLUSTER PINE BUDS.

ornamentation that gives to these cones a distinctive appearance. The fruit is ripe in late autumn, when the scales gape open, setting free the seeds. The empty cones fall later.

THE PINES

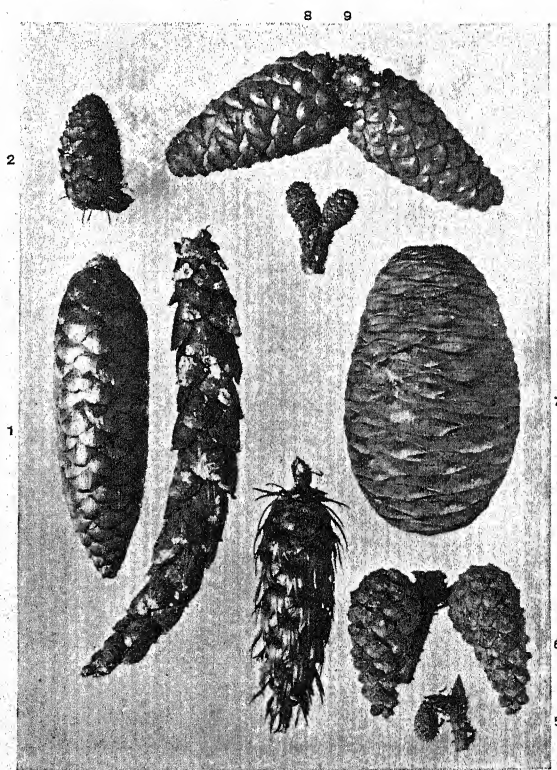
The shape of a Pine early in life is pyramidal, but later this symmetry is generally broken. The leaves are long and narrow, aptly characterised as needles. They are not solitary, but grow in bundles of two, three, or five, which are confined at the base in a sheath. A Pine cone, after forming, ceases to grow throughout the first year. It starts into growth the following spring, generally maturing by the next autumn. The small lump, or boss, is always present on the exposed part of each cone-scale. The cones are pendent, and they release their seeds by opening their scales.

The Scots Pine. This is our one native Pine. The mature habit of this tree is to cast off its lower branches, sustaining, on tall stem, a rounded or flattened crown. The bark near the base thickens, exhibiting a series of dark, flattened plates, separated by fissures; but higher up, where the thin scales peel off, the general surface is of a bright coppery colour. The needles, two in a bundle, united at the base in a brown sheath, are bluish green. Their length is about two inches. The cones, which are about two inches long, and taper

quickly, grow sometimes three together, but generally in pairs, side by side, with their central axes parallel. The exposed part of the cone-scale is four-sided, and is raised to a point in the centre. Its surface is not polished.

The Corsican Pine, and its Austrian variety, may best be distinguished from the Scots Pine by the following: The bark is fissured and uniformly thick and dark, from the base to the summit. The bud is cone-shaped, with a long-drawn-out point, silvery, and thickly covered with resin. The needles, two in a bundle, and sheathed at the base, are rather longer and of a darker green. The cones also are larger, and as they grow in pairs their attitude is different. They are attached base to base, with their central axes in a line, or nearly so. They have a polished surface.

The Cluster Pine. The bark is dark, coarse, and deeply furrowed. The buds,



CONES OF CONIFERS.

1, Spruce. 2, Larch. 3, Weymouth Pine. 4, Douglas Fir. 5 and 6, Scots Pine first year and full grown. 7, Cedar. 8 and 9, Austrian Pine first year and full grown.

about an inch long, are torpedo-shaped. These are not coated with resin, but the ends of the scales curl outwards. The needles, two in a bundle, and sheathed at the base, are six or eight inches long, and

as to give the cone a spiked appearance. The cones often remain on the tree for years.

The Stone Pine. From its spreading manner of growth this is often spoken of



SCOTS PINES.

thick in proportion. They are clustered together on the branches and form handsome tufts. The cones grow several together, radiating round the branch. Each cone is about six inches long and unevenly developed, bulging on the exposed side, and curving towards the point. It has a shiny surface. The central swelling on each scale is so pronounced

as the Umbrella Pine. The bark is reddish grey, thick and deeply furrowed. The buds are conical and have curled scales. The needles, two in a bundle and sheathed at the base, are similar to those of the Cluster Pine. The cones are not clustered, they are nearly globular, their scales are not spiked, but show a raised flat surface with a central depression.

They require three years to reach maturity. Their contained seeds are large, suggestive of a fruit-stone, hence the name Stone Pine. Each seed has a tiny wing wholly inadequate for any purpose of flight. This Pine has, in its later evolution, come to rely upon animal agency for the dispersal of its seeds.

The Weymouth Pine. The needles here are five in a bundle, sheathed at the base only when first expanded. They are long, very thin, and soft in texture. These are also crowded together, forming considerable tufts, spreading in summer,

but closing together in winter. The cone is long and thin, spindle-shaped, and curved. Its most distinctive peculiarity lies in the fact that the swelling on the cone-scale is not central but at the tip.

The Himalayan Pine is scarcely distinguishable from the Weymouth except that its needles are longer and its cones larger every way.

Note.—Other imported Pines are "too numerous to mention," but those briefly distinguished above are most frequently met with.

HENRY IRVING.

THE RUSHES

By MAUD U. CLARKE

With Photographs by HENRY IRVING

THE true Rushes are a small family that, nevertheless, spread themselves in ample fashion over the world.

The general impression of the Rush, as recognised in such common varieties as the Soft Rush, Hard Rush, etc., with cylindric leaves and inconspicuous flowers, would hardly lead us to suppose that the plant was a near relative of the Lily family. Yet such is the case, for in the classification of the Order *Hypogynæ* (plants having the perianth, or corolla and calyx collectively—inferior, or absent altogether), the *Liliaceæ* and *Juncaceæ* have many points in common.

The two Orders are placed consecutively: in both, the sepals, petals and carpels number three in each instance, the stamens six—as a duplication of the idea of three—the seed-capsule is three-chambered, and the seeds either three or many.

To ordinary observation a great difference exists between the conspicuous flowers of the Lily family, and the inconspicuous brown ones of the Rushes; yet the magnifying glass dispels the illusion to a very considerable extent.

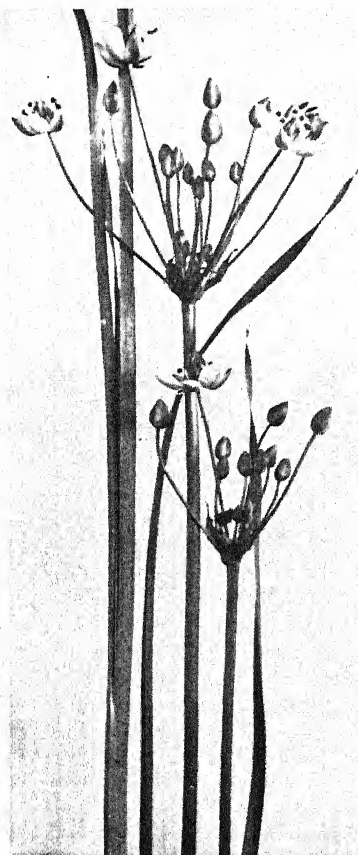
Of the Lily family, I would instance the Bog Asphodel (*Narthecium ossifragum*), with its tufts of grass-like leaves and yellow star of six petals, and the Flowering Rush (*Butomus umbellatus*)—a single specialisation from the *Alismaceæ* or Water Plantain family—as showing distinct relationship to the Rushes. The latter plant has six rose-coloured perianth leaves, the three outermost tingeing towards brown and approaching the colour-idea of the perianth leaves of the Rushes. The long leaves of the *Butomus* are in character sharply keeled and sheathed on the stems like the Sedges, yet the flowering construction is that of the Rushes.

A magnified flower of *Juncus compressus*, with the six oval perianth leaves expanded showing the six stamens lying within them surrounding the seed-capsule, has a close resemblance to that of the Flowering Rush, although the latter plant possesses nine stamens and six carpels. The tribe *Juncaceæ* are definitely distinguished by the cylindric leaf of polished surface filled with pith; they are sometimes grooved, but rarely flat

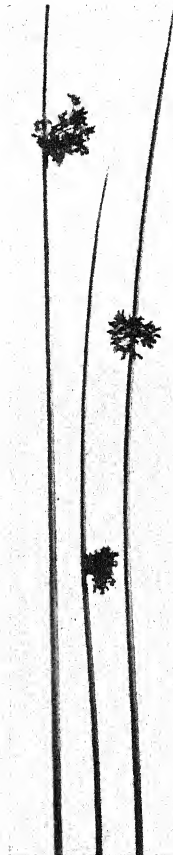
like grass. The flowers are either distinct, or grouped in irregular panicles, the seed-capsule being three-celled and containing many seeds. The plant is always associated with more or less marshy or boggy ground.

If we pull a specimen of *Juncus com-*

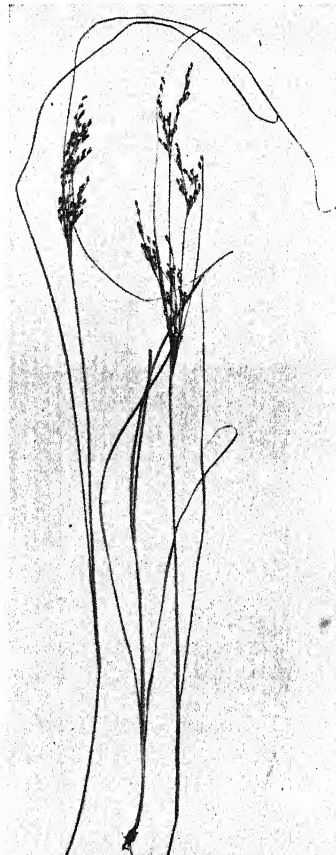
emerge above the surface of the ground, very sharply pointed, and varying in colour from whitish to a bright chestnut. The species has two extreme forms, that of *Juncus glomeratus*, or Dense-flowered Rush, and *Juncus effusus*, the Loose-flowered variety. There seem to be very many



FLOWERING RUSH.



JUNCUS COMMUNIS.



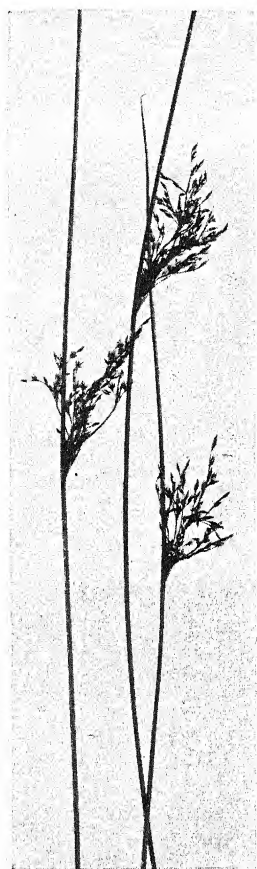
ROUND-FRUITED RUSH.

munis carefully from the ground we find the green leaf emerging from two chestnut-brown sheaths that partially wrap round the base; the inner one extending five or six inches upwards upon it, the outer, and darker one, for about half the length. These sheaths are of stout texture, admirably waterproof, toughening where they approach the root, and thinner in the upper extremity where they only partly enfold the leaf. The rootstock is a running one, with fibres extending from it; from the root the young leaf-shoots

gradations between the two—often found in close proximity to each other.

In autumn the partially dry stage of the Rushes gives a beautiful mass of orange colour to the landscape, the tips of the leaves and stems being so tinged before they fade later into the varied grey and drab tones so appreciated by the painter.

The Hard Rush (*Juncus glaucus*) differs mainly in the more rigid and slighter form of stem, which is finely grooved and of a grey-green colour, and the looser panicle



HARD RUSH.

places, growing together with the Soft Rush on boggy commons or round the margins of ponds. *J. effusus*, very like the Hard Rush, is said to be a hybrid between both varieties. I met with it recently, and found the stem rigid some little distance from the base, the grooves quite distinct; but in the upper length it became softer, slightly flattened and twisted. The panicle was of the loose vertical order, the ripened capsules broadly oval, but showing the distinguishing point of *J. glaucus*.

In *Juncus compressus*, or Round-fruited Rush, the stem is also slightly compressed



GREAT WOOD RUSH.

through the summer.

Another Rush that stands apart from the type-form, with cylindric leaves, is the Heath

at the base. It is a very slender, erect Rush, not more than one foot to one and a half feet high, and making a departure from the type in having a few nearly radical leaves, and one or two higher on the stem of the channelled order and narrow in form. The panicle is a loose terminal one of shining brown colour, the flowers arranged singly, or rarely clustered. The small perianth segments are rounded, as referred to previously in connection with the Flowering Rush. It lives in wet, marshy places, especially near the coast, but is not so generally spread over Britain as the other Rushes, and not often inland. The flowering lasts all



HEATH RUSH.

Rush (*Juncus squarrosus*). Adapted to drier regions than others of the family, its characteristics incline towards those of the Grasses. The leaves are all radical, save for a bract leaf on the flowering stems in some instances, and spread in tufts laterally; they are of narrow grooved shape, stiff in character, and not more than half the length of the stems. The flowers are contained in a terminal panicle that is little branched. The perianth segments are of a glossy brown colour and broad in form, as seen in the illustration, enclosing the seeded fruit of the two principal stems. At the top spikelet of the taller stem we see the style of the carpels still adhering, the extremity being a three-forked arrangement of slender threads. The species is quite abundant over Britain on moors and heaths; the rigid stems are under one foot in height.

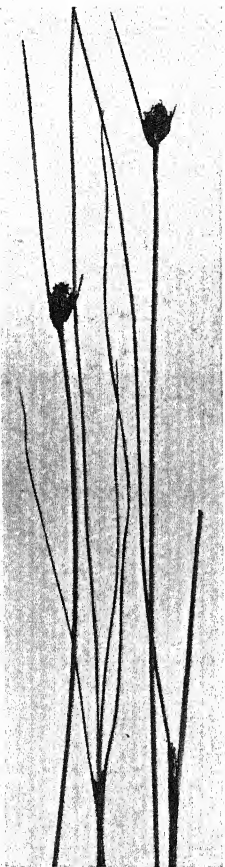
A departure from type-form is even more marked in the Great Wood Rush (*Luzula sylvatica*), for here the generic name has been shifted to meet the requirements of the plant's specialisation. There is much difference in the soft flat leaves that approach those of the Grasses, and are covered thinly with white hairs. Another distinctive character is the one-celled capsule, which contains but three seeds, larger than most of the species. It prefers dry situations—woods or pastures that are well drained or stand at an elevation; the height varies from one and a half to two feet, the leaves being rather less. The flowers are expressed in little clusters of two or three in a large, loose panicle.

One of the Rushes associated with the damp regions that has some superficial resemblance to this form of panicle is the Jointed Rush (*Juncus lamprocarpus*). A

slender compressed stem bears the panicle, that is leafy to some extent. The peculiar formation of the radical leaves gives the name to this species; they are first sheath-like upon the stem, but afterwards cylindrical and hollow, divided

interiorly by cross segments of pith, which mark such divisions clearly in the dry state, and give the appearance of articulated joints. The flowers are in small clusters—from three or four to as many as ten—arranged in compound terminal panicles. The perianth segments are about the size of the Common Rush; the capsule more or less pointed. It is an exceedingly variable species in habit and size, but always to be distinguished by the jointed leaves. I have found it on damp commons in both its extreme measurements, viz. in rich soil, from two to three feet, with panicles five or six inches diameter; and also in its diminutive form of a few inches only, when the panicles are less complex and of a much darker brown colour. It will also spread over water, rooting at the joints, which appear to be centres for possibilities of varying requirement.

I have used some latitude in placing the Black Bog Rush (*Schœnus nigricans*) with this selection of plants, since it is not a Rush from a botanical standpoint, but a Sedge. It is, however, so rush-like in general appearance, more nearly approaching type-form even than the Wood Rush, that it appeared to me the more interesting to show the plant as a rush-like Sedge among Rushes, than in its own class. But let it not be forgotten that the fruit is the single nut-like seed that separates the plant at once from the Rush family. The small rounded spike of glumes is variably a dark reddish brown or black-brown, composed of three or four

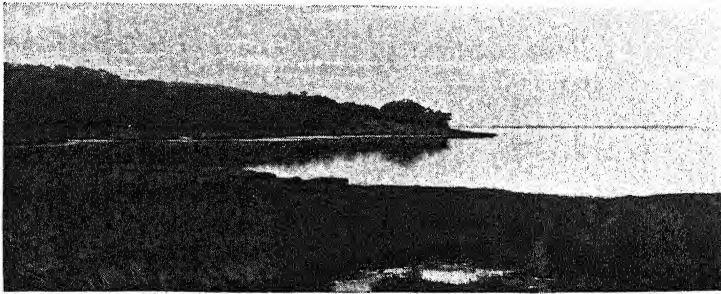


BLACK BOG RUSH.

to ten spikelets grouped closely together, and surrounded with broad, brown, leafy bracts stiffened at the tip into points extending in some cases considerably beyond the spike. The spikelets are without stalks, and contain one to four perfect flowers, the other glumes being empty; the perianth of the tribe *Schæenus*, or Bog Rush, has either the construction reduced to a few bristles or it is absent altogether. There is a

noticeable character in the way the sedge-like sheathing base of the leaf abruptly alters into the more rush-like contracted form, with a tendency to flatten and twist upon itself. In all these bog plants there is careful supply of the waterproofing construction at the base, where special membranous bract-forms meet the emergency of habitual contact with water.

MAUD U. CLARKE.



Photograph by T. Meyer, Stratham, S.W.

POND LIFE—III

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

IF we pay a visit to a pond covered with Duckweed, and carefully collect some so as not to injure the slender, submerged stems and roots, and on our return home place our treasure in a glass tank filled with water, we shall probably be rewarded by finding that we have also obtained some specimens of one of the most interesting inhabitants of the pond. On looking carefully at the miniature forest of Duckweed stems, as they hang downwards in the tank, we shall see that some of the stems have attached to them what looks like a tiny greenish lump. After watching the lump for a few minutes, we shall see it begin to elongate, and a circle of slender arms or tentacles will appear round the top, something like a little crown of waving snakes. This quaint little animal—for an animal it is, and not an excrescent growth on the side of the stem—is called the Fresh-water

Hydra, and has gained its popular name from the crown of waving arms.

The Fresh-water Hydra is a relation of those exquisite Garland Polypes, the Compound Hydrozoa, which inhabit the rock pools on the seashore. Its life-history is not quite so remarkable as that of its marine relations, as it never becomes a true colony, nor does it produce tiny Jelly-fish babies, but, nevertheless, it is a very interesting and curious little creature. For instance, it does not remain attached to one spot throughout its life, but is very fond of shifting its quarters from one place to another; and to watch it travelling down the submerged stem of a water-weed, or along the glass sides of the tank, is to witness a very remarkable gymnastic performance. When the Hydra wishes to change its quarters, the tiny creature elongates its body and arms, and bending over sideways until its body

forms a loop, brings its head and arms in contact with whatever it may be resting on. The Hydra, grasping this support with its arms, now relaxes the hold which attached the base of the body, and slowly turns a complete somersault. In this way, alternately using its arms and "foot," the little creature moves along by a series of stately somersaults until its destination is reached.

With the aid of a good hand magnifying glass, we can make out more clearly some of the characteristics of the Hydra. In the centre of the waving circlet of arms is an opening, which is the mouth of the creature, and which leads straight down to the digestive chamber. Close inspection of the arms, or tentacles, will reveal the fact that they are more or less thickly covered with very complex cells, the stinging cells, or *nematocysts*, by means of which the Hydra wounds and captures its prey. These stinging cells are similar to those found on the tentacles of the Sea Anemone, which I have already described on page 380.

If a healthy and well-nourished Hydra is kept under observation in a small glass jar, a little nodule will be seen to make its appearance on the side of the animal's body, and to grow outwards and develop a crown of tentacles which wave about and capture any minute organisms that come within their reach. This baby Hydra grows, and after a time, becoming detached from the parent, settles down on its own account. Sometimes the Hydra develops a waist, which becomes smaller and smaller until the top half breaks off. This upper, tentacle-crowned portion then develops a base, while the fixed lower portion grows a crown of tentacles. In the autumn the Hydra produces eggs, from which escape the young, which gradually develop their tentacles.

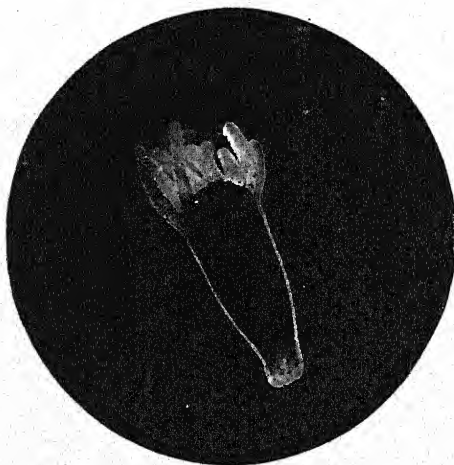
At certain seasons of the year, a glass of water drawn from a pond will be found to contain a large number of more or less oval-bodied creatures, which move about very rapidly in the water with a curious jerky motion. From their quaint mode of progression, these little creatures have gained their popular name of Water Flea, although really they are not insects at all, but distant relations of the shrimp and lobster, belonging to that group of animals which are included in the Crustacea. Occasionally they appear in such vast quantities as to give the water quite a milky appearance, and finding their way into the domestic water

pipes, cause considerable trouble.

The movements and general appearance of the Water Flea, or *Daphnia*, to give it its scientific name, are very interesting to watch with the aid of a good hand magnifying glass, or, better still, under the microscope. It will then be seen that the little animal is enclosed in a transparent, oval or nearly circular shell, terminating at the base in a sharp serrated spine. So

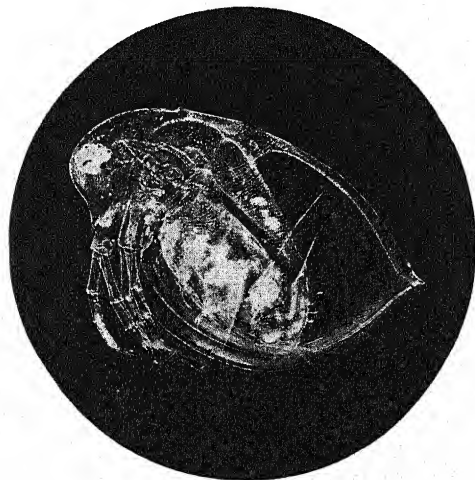
transparent is the shelly casing of the body, that most of the internal anatomy of the Water Flea can be easily distinguished, and under the microscope, with a moderate magnification, the heart may be seen beating. The eye of the Water Flea is a very bright and handsome organ, and looks like a tiny jewel.

The Water Flea belongs to the division of the Crustacea called the *Entomostraca*, and this division includes, as well as the Water Flea, other small and interesting inhabitants of the pond, called respectively the Cypris and the Cyclops. The little Cypris differs considerably in size and appearance from the Water Flea; the shell is not quite so oval, but rather more like the seed of a haricot bean, or a kidney, in shape; and is generally fringed or covered



FRESH-WATER HYDRA.

with short hairs. The three forms most frequently met with are the Green, the White, and the Brown Cypris; all to be found swimming in ponds.



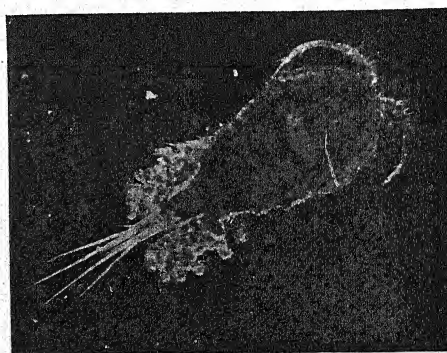
THE WATER FLEA.

The most familiar Cyclops, and one that is to be found in most ponds, is the Four-horned Cyclops (*Cyclops quadricornis*), which has an oval head and tapering body terminating in two groups of stout bristles. This Cyclops has gained its popular name from the four horns or antennæ which adorn its head. The female is easily distinguished, as she carries two pear-shaped egg-sacs or ovaries, one on each side of her tapering body. Besides the common Four-horned Cyclops, Lord Avebury has described six or seven short-horned species as being fairly common in the Kentish ponds.

It is well for the Water Fleas that they are such a remarkably prolific tribe, for otherwise they would soon become extinct, so numerous and voracious are their foes. Nor are the enemies of the Water Flea confined to the animal kingdom, for there is one remarkable pond plant which must account for a comparatively large number in the course of the year. This is a plant called the Bladderwort (*Utricularia vulgaris*), frequently to be found growing in ponds and sluggish streams. It is a curiously interesting plant, living and floating at the surface of the pond during the spring and summer, but sinking to the bottom at the approach of winter.

Its straggling stem bears numerous, much-divided slender leaves, and for a few weeks in the summer it sends up a flower-stalk bearing quaint orchid-like golden blossoms. But the most remarkable feature of the plant consists of the numerous little oval bodies attached to the submerged stem, which look like tiny bladders or floats, and from which the plant has gained its name of Bladderwort. At one time it was generally supposed that these processes acted as bladders to buoy up the plant and keep it afloat near the surface of the water. Modern scientific research has proved, however, that this is not the case, but that these bladders play a very important part in providing certain forms of food necessary for the growth of the plant. Indeed, we now know that the Bladderwort belongs to that curious and intensely interesting group—the carnivorous plants. All these plants grow in more or less marshy situations, where the supply of nitrogen in the soil—so necessary to their growth—is low; as a consequence of this environment, they have, in the course of ages, gradually evolved special organs for obtaining the required supply of nitrogenous material by other means than from the soil.

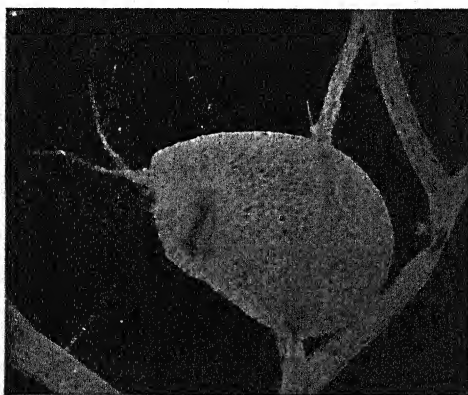
In the case of the Bladderwort, the



THE FEMALE CYCLOPS.

supply of nitrogenous material, required by the plant for the building up of its tissues, is obtained through the agency of the bladder-like processes. When we come to examine these "bladders" closely, we find that they are really very complex organs. Each is a hollow chamber, the entrance to which is closed by a semi-

transparent membrane or door; this can be pushed inwards by any small creature desiring to enter, but it closes again, and cannot be opened from the inner side. Whether the Water Fleas, like most creatures, are imbued with the sense of curiosity or not, it is difficult to say, but that they are attracted to the bladders is very evident. They swim about with their curious jerky motion amongst the bladders, and finally push open the alluring trap-door, and discover too late that they are within a prison from which



ONE OF THE "BLADDERS" IN WHICH THE
BLADDERWORT ENTRAPS WATER FLEAS.

escape is impossible. Within these curious bladder-like prisons the Water Fleas soon die, their bodies are decomposed by bacteria, and the products of decomposition are absorbed by the plant and stored within its tissues to be utilised in the process of nourishment and growth.

The beautiful little Water Mites, cousins of the Water Spider, abound in the ponds throughout the summer months. Some idea of how numerous these Water Mites are, may be gathered from the fact that Mr. Saville Kent has detected about forty British species. Perhaps the most conspicuous is the Round Red Water Mite, which has a rather convex, purplish red body, and red feet and palpi, and is present in most ponds. The Great Water Mite (*Hydrachna geographica*) is one of the largest species; it has a black, nearly spherical body marked with red spots, and the ends of its legs are red in colour. A rather common Water Mite, called the

Harlequin (*Atax histrionica*), has an oval, dark red body, and blackish green palpi and legs. Other Water Mites well worth seeking are the Hunchback (*Arrenurus globator*); the Walking Mite (*Limnochares holosericeus*), which crawls about instead of swimming; the Claret Mite (*Hydrachna cruenta*), which attaches its eggs to the stems of the *Potamogeton*; the Furrowed Mite (*Eylais extendens*), and the Yellow Mite (*Atax lutescens*). To the amateur microscopist the Water Mites will be found a very interesting group for investigation, and will yield a large number of beautiful objects with which to enrich his cabinet of slides.

Attached to the submerged stems of various water-weeds, and more particularly to old stems, we shall find the tiny towers which form the home of the Brick-maker Rotifer; one of the most beautiful and wonderful inhabitants of ponds and slow-moving streams.

The Brickmaker and its tower are of diminutive proportions, and therefore easily escape notice unless careful search be made amongst the tangle of stems. The best plan is to place two or three stems at a time in a wide-mouthed glass jar, and to examine them critically with a hand magnifying glass for the little Rotifer tubes, which rarely exceed an eighth of an inch in length. The selected stems should be carried home in a glass jar or tube filled with water, and then placed in a small aquarium. To appreciate fully the beauties of the Brick-maker, we should place a branch bearing some of the tubes in a zoophyte trough, and examine them under a low-power object glass of the microscope. And what a wonderful sight is then revealed! The tiny tube is seen to be composed of row upon row of minute round pellets or "bricks," each with a central hole. As we watch, a silvery mass is seen slowly to rise from within the tube, and gradually to expand like some dainty, fragile flower. The petals open until the whole reminds us of a miniature, silver pansy blossom.

Around the edges of the shining petals constant movement is taking place, as if some invisible hand were at work, winding a tiny chain. This motion is due to a fringe of delicate hairs, moving

rhythmically, and producing a vortex current which catches, and carries down on to the centre of the flower-like expansion, minute particles of animal and vegetable matter; for these extremely delicate hairs or cilia are the organs with



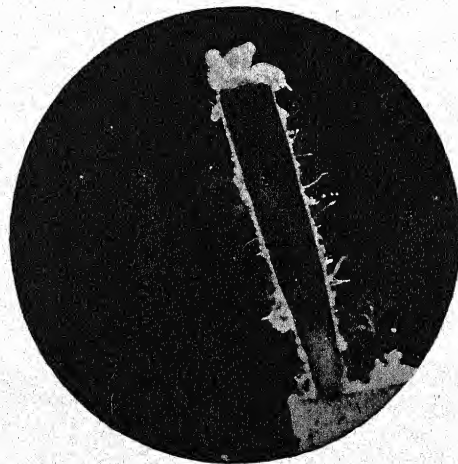
A RED WATER MITE.

which the Rotifer captures its food. Should some larger denizen of the pond flash past, the little flower-like head of the Brickmaker instantly contracts, and disappears within the protecting walls of the tiny tube, only cautiously to reappear when the danger has safely passed.

If we watch very carefully we shall be able to see how it forms the bricks of which its tiny tower is built, and how it places them in position. The bricks are practically composed of the indigestible portion of the Rotifer's food, which is gradually collected round a curious little "stud" on the neck of the animal. When a sufficient supply has been accumulated to form a brick, the Rotifer is seen to elongate its neck, and bending over its flower-like head, bring the neck-stud into contact with the top of the tower, and the newly formed brick is placed in position. With just a little attention to see that the water is kept sufficiently oxygenated, these beautiful and remarkable Brickmaker Rotifers may be kept in a small aquarium for a considerable time, in a healthy and active condition. A very interesting experiment may be carried

out, with the exercise of just a little care, by placing a portion of a plant stem to which some young Brickmakers are attached, in a zoophyte trough, and introducing into the water a small quantity of crushed leaves of the water-plant, to which a little aniline stain has been added. Only a very little of the infusion is necessary, and at the end of a few hours, if examined, the tiny tubes which are in process of building will be seen to have one or more tiers of coloured bricks. By this means, and with the exercise of sufficient care in giving a fresh supply of infusion of another colour daily, or every other day, the little Rotifers may be induced to build their towers so that they are composed of layers of different coloured bricks.

One of the most magnificent of the Rotifers to be found attached to the submerged stems and roots of the water-plants is the so-called Crown Animalcule (*Stephanoceras*), which does not surround its body with a tower like the Brickmakers. When seen in a thoroughly vigorous condition, with its wonderful "crown" fully expanded, *Stephanoceras* is one of the most beautiful inhabitants of the pond. Although a large proportion of the Rotifers lead a sedentary



A BRICKMAKER ROTIFER'S "TOWER."

existence, attached by their base to the stem or leaves of some aquatic plant, there are a very large number which lead a roving life, travelling through the

water at a very rapid rate, and which are most curious and interesting to watch under the low powers of a microscope. So transparent are they, that when



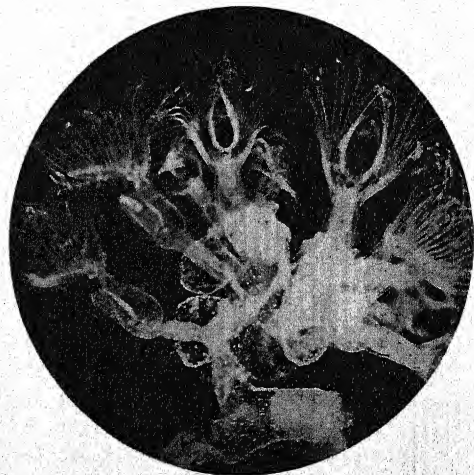
TWO FREE-SWIMMING ROTIFERS.

resting for a few moments, so that it is possible to use a higher magnification on the microscope, it is quite easy to discern the whole of their internal anatomy and to watch the process of digestion.

In collecting the stems and roots of the water-plants while seeking for the Brickmaker Rotifers, we are certain also to find some masses of the beautiful *Vorticellæ*, or Bell-animalcules. They are singularly graceful, these frail, minute creatures, with their long, slender, anchoring stems, crowned by their cup-like bodies, the rim of each cup bordered with a fringe of ever-moving hairs. An active group of these Bell-animalcules presents a most extraordinary scene of animation. The slender stems sway gently from side to side, and then suddenly contract into a graceful spiral, only instantly to shoot forth again to their full length, while the fringe of delicate hairs or cilia which surround the edge of the cup-like body are kept in constant motion, producing vortex currents by means of which these interesting creatures capture their prey.

Of extraordinary interest are the fresh-water representatives of the beautiful Moss Animals (*Bryozoa*), of the rock-

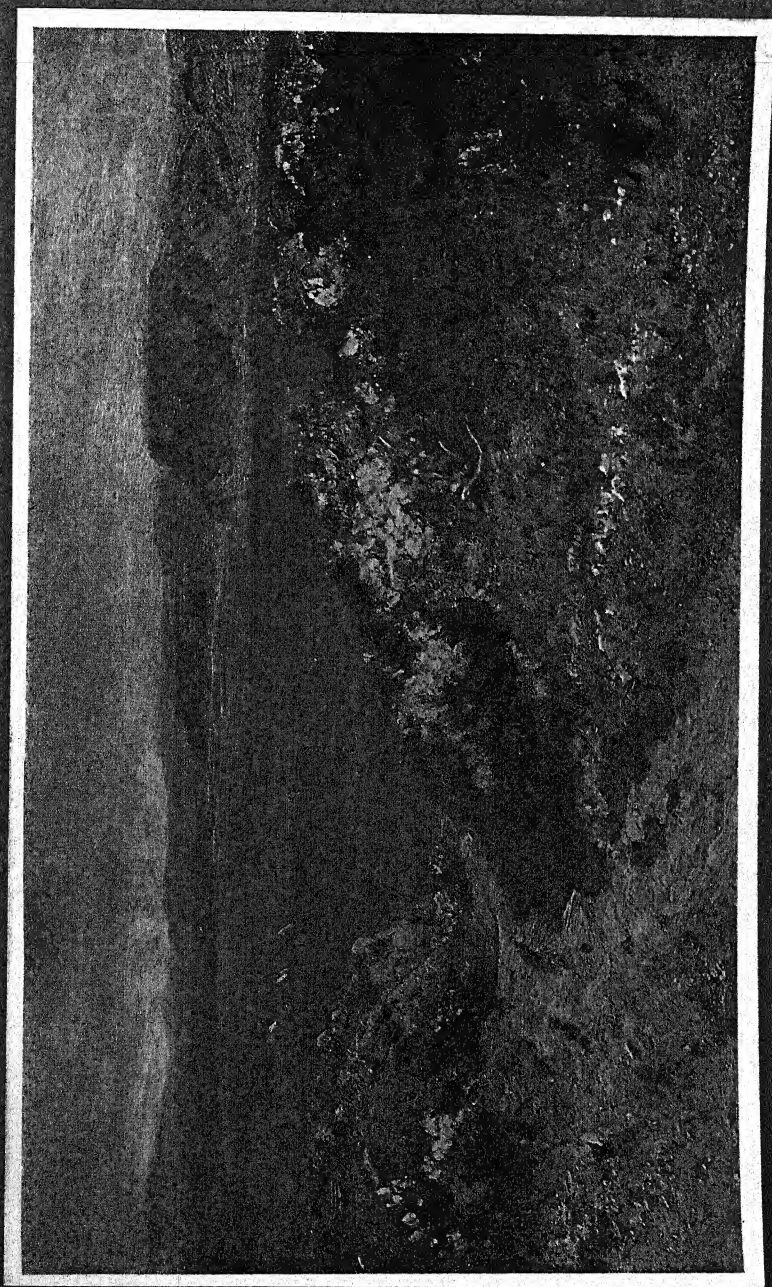
pools on the seashore. Of the pond-dwelling *Bryozoa* the beautiful *Cristatella* is one of the most remarkable and interesting, distinguished alike for the beauty and number of its tentacular breathing organs, and for its active habits; it creeps slowly, by means of the flattened under surface of the colony, which forms an oval and contractible disc, over the submerged stones and stems. *Lophopus* is another interesting fresh-water Bryozoon, each member of the colony bearing a wonderful series of delicate tentacles arranged like a horseshoe or crescent-shaped crown. These beautiful and interesting creatures are well worth seeking, and are far more numerous in our ponds and streams than is generally supposed. To quote Dr. Allman, who paid so much attention to these fresh-water forms of the *Bryozoa*, they "may be sought in the still and running waters of the land, in the broad river and the rushing stream, in the pure, cold mountain lake, and the stagnant waters of the moory fen. In interest they yield not one jot to their brethren of the sea, and offer to the



LOPHOPUS: A FRESH-WATER MOSS ANIMAL.

naturalist an inexhaustible source of gratification in the beauty of their forms and the wonders of their organisation."

F. MARTIN DUNCAN.



THE CORRAL CREEK IN JUNE
From the Valley by Arthur J. Black



Photograph by E. J. Wallis, Kew Green.

"IN THE GLADES THE CHASTE WHITE SNOWDROPS, PLEADING FOR SPRING.

VERNAL DAYS

By R. A. STAIG

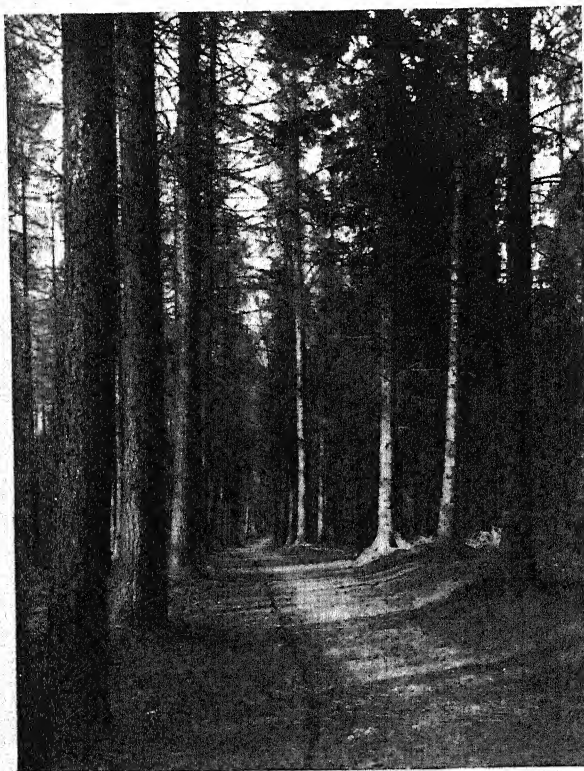
"Moist, bright, and green, the landscape laughs around."

WHO could say when Spring began? Through the last months of the old year there were touches of new-formed green, and scarcely a day passed without a fresh bloom or a blossom; always something new appearing somewhere: brown moths along the bared hedgerows, the clear-winged gnats whose spring is winter, spots of gold on the wayside whins; each hibernal hour the springtime of some life. There were intervals when thrushes sang. After the first snowfall yellow stars opened on the

jasmine; and sweet perfumed flowers, glistening white and rose-pink, clustered around the stiff, leafless mezereon stems. True to its time the lowly aconite, the short stalk with the green frill bearing the golden cup.

Light increasing, and the dulling influence of darkness on the wane. The life-sap rising, plant stem and tree trunk; buds swelling on the branches. The caterpillar quickening in the tiny egg. The "chi-kurr" of the partridge to his mate. Dawns the day of the warmer

wind and the softening of the frostbound earth. Slowly the crisp white covering melts away—what wondrous profusion of young and tender green points peeping above ground! They could not push forth fast enough, all the hosts of little seedlings, all the sprouts of springing



SUNSHINE AND SHADOW IN THE LARCH WOOD.

herbage. Dog-mercury plainly visible among the withered woodland leaves; the flower spathe of the wake-robin hurrying before the arrow-fashioned leaf; and in the glades the chaste white snowdrops, pleading for spring.

Effulgent beamed the fitful sun. Transient rays, not with much power but with magic touch, bringing expectancy upon the face of Nature. "Phew!" whistled the starling, the prolonged exclamatory whistle, and forth from his tuneful throat came the gurgling notes of vernal prophecy, sounds of pure joy. Gladdening to watch him so jubilant in the welcome flood of genial sunshine.

Is there any bird more optimistic? No seasonal mood so sullen or so surly that it can crush all hope from out the starling's breast. He broods no cloud, sees ever the blue beyond, expresses it in his tremulous melodies through the dullest hours.

Ethereal mildness, breath of reviving spring; the old fly felt it and staggered forth, weak-jointed and feeble, from the dark crevice in the wall. The passing sunshine hastened the transformation of the bulb tips into white-striped spears and green expanding blades. It warmed the young perennial shoots coming fast about the old shrunken stems and opened the golden discs of the early coltsfoot and the dandelion. It flowered the burn-sides with the lilac-pink of the butterbur, and decked the hillside hazels with drooping yellow catkins.

Some withered leaves rustled mysteriously among the roots of the beech hedge. Cautiously a small quivering snout appeared, sniffing the air with a fine precision. But the grubs would be scarcely fat enough and beetles few, so he would sleep yet awhile: knowing hedgehog!

Clouds of gathering grey blotted out the sun. Suddenly the wind rose, whirling the snowflakes and scattering the finches chattering along the hedgerows. Once again all

Nature mantled white, and everywhere a solemn stillness, unbroken save by sounds of muffled wheels and querulous call of bird. And through many days, but little to be pencilled in the record of outdoor life.

With what joy did one hail the unmistakable signs of coming change, the breaking up of the leaden sky into patchy sunlit clouds borne onward on the southwest wind.

It was pleasant to see the sun-tinged raindrops falling, pleasant to feel again the enlivening touch of the balmy breeze. There might yet be storms to come, chilling showers of sleet and tearing,

cutting winds there would be, and the keen night frosts; but the power of spring was over all, unfolding the buds, opening the blossoms, bidding the birds to sing, calling forth the myriad insects. Damascene purple, white, and yellow, the crocus chalices opened in the garden, and presently a bee visited them.

"Ere a leaf is on a bush,
In the time before the thrush
Has a thought about its nest,
Thou wilt come with half a call,
Spreading out thy glossy breast
Telling tales about the sun;
When we've little warmth, or none—
Little humble celandine."

And there were the little tree-creepers,



Photograph by E. J. Wallis, Kew Green.

"STRETCHING AFAR A WAVING SEA OF PALE GREEN SPEARS AND BLAZONED TRUMPETS,
MARSHALLED FORTH BY SPRING."

With lengthening spells of favourable temperature the vernal tide flowed steadily forward; a new bud, an expected flower, a welcome voice, all the cherished living things coming out in endless succession, Nature filling in the gaps.

For so long had the woods been bare, dreary, well-nigh deserted, only the disturbed pheasant, the whirr of partridge wings, a hooting owl; and the mosses spreading velvet green. It seemed an age before the celandines bloomed again—first of the woodland flowers—brightening the accustomed places where their heart-shaped leaves had arisen.

feathered mice, spider hunting, working up and round and down the perpendicular trunks, making pivots of their tail feathers. And the charming tits, as nimble as ever, and so many; wherever had they all come from! Flitting from tree to tree, swinging from branch to branch, hanging on the twigs, peering round corners, "chee, zee; chee, zee," an eye here, a peck there, searching every cranny of the bark, restless, inquisitive, prospecting. 'Twere a dull wood without these Pucks of birddom. In full nuptial dress in the clear spring-light, at no other time are the rich hues of their plumage more lovely.

With vesture so gay the tits' love-story began; by-and-bye in the bole they would weave together emerald moss and filaments of wool, cosy nest for the tiny mottled eggs.

In their own way how glad must the larches be to have the warm sun streaming through their branches, casting the shadows of their tall tapering trunks across the shining mossy path. Gradually, as the days passed, had these gaunt conifers gained breadth of sprouting green. Small pink tassels on some of the branches revealed the future cones; others showed the lesser yellowish knobs, waiting for the breeze to carry the pollen gold to the pink. Such is the "wind-love" of the larch.

A sign of the season is the matchless gloss of the starling's coat. It tells of mating time and the happy birds; of "showing off," and rivals to be outdone, and quarrels to be pecked out. Chaffinch, wren, hedge-sparrow, and how many more, all of them too preoccupied to trouble about the vagaries of the weather. Sly goings and comings to and fro, the ditch bank signified an early chosen site. There he was with a fibre in his beak, happy married robin. All day long in the glare and heat of summer the yellow-hammer sings, common notes, commonplace as the dust on the highway; but now so precious every note of the old familiar refrain about the "little bit of bread and no cheese," precious as the leafing buds of the hawthorn hedge where he sits.

Light-hearted, up and up a skylark fluttered, soaring far away up where no eye could follow, carolling in the vault of the heavens. No morn now without the joyous lilt of singing bird, the sweet music of the mavis, the blackbird's spirited fluting.

Blustering winds ruffled the feathers of the building rooks, but neither gusts nor lashing hail could stay the progress of the rookery. From the marsh pools "qurk, qurk, qurk" sounds the shrill chorus of the amatory toads, swimming among their long slippery strings of ova. The deep-croaking frogs had forgathered there before them—heavy masses of cold quivering jelly lay in the water, eggs within gelatinous globules; some already hatched, tiny tadpoles. Lethargic under

the mud, how did the frogs know when exactly to come forth?

When winter reigned, and all was desolation in the wooded park, it meant so much just to know that those treasures of floral splendour, the Lent Lily bulbs, were there, beside the roots of the withered grasses, awaiting the call; and then to come again and find the numberless green points newly risen; but later what pleasure inexpressible walking among the trees to view the glorious legions of golden daffodils stretching afar a waving sea of pale green spears and blazoned trumpets, marshalled forth by spring.

Like the ways of the child are the moods of Nature at this season, all smiles and then all tears; but the laughter will out ere the tears are dried. And she has no fixed order for anything, no immovable dates for appearances. You cannot say, "Come, it is sunny, we will go and see the bronze-scaled slow-worms on the bank among the dried brackens, where they were this very day last year." Or was it written in your almanack that the sweet perfumed primroses studded yellow the sheltered dell? And you went there expectant. Only the flower-stalks coming; but violets so lovely, "sweeter than the lids of Juno's eyes, or Cytherea's breath," and there, too, the first frail windflowers, and a brown lizard squat upon a sun-exposed stone.

Big orange-belted bumble bees joined the murmurous brotherhood at the sal-lows, impatient for the "pussy-cat claws" to open, golden "palms." Earlier than expected, the first sand martins had arrived. So often the unlooked for with Nature; always surprises. One evening it is a bat flitting up and down the avenue; next morning out pops dapper "Squgy" with his beautiful "brush," and someone has found a starling's egg lying unbroken upon the sward, spotless pale blue.

With measured step the sower walks the brown earth acres, casting the seed in handful showers. Over the field the lapwings fly, a swift, smiting flight, "whee-a-weet, pee weet," tumbling, descending, doubling back; again "pee weet," higher, more distant. Their frantic swoops and cries tell of blotched brown eggs exposed in a hollow near at hand. Look and better look, yet they may be

crushed under foot unnoticed, so close is their resemblance to the stones and earth. Before nightfall the farm worker will collect a pitcherful for his supper. No resemblance so subtle that it can long defy the scrutiny of observant man. In the pasture, aloof and motionless, under the lee of the dry stone dyke, stands a ewe with her new-born lamb; one more bleating voice to join in the frolics of spring.

Spring's procession of life rapidly advances in all its wealth of colour and form. Each day brings added pleasures, fresh interests, something new or beautiful or good, the exquisite curl of a fern, the bursting tulip, a spotted ladybird, that "primrose of papilions" the brimstone butterfly, the chiffchaff and the swallow from over the sea, wild cherry blossom—pellucid, waxen white, the golden cup of the marsh marigold, sunshine and the

shower softly falling. Along the hedge-banks ground ivy and the bright speedwells are spreading blue. Soon the wild hyacinths, blue and scented, will come again in the woods and coppices, and the cowslips in the meadows. Upon a spray of blossoming blackthorn the chaffinch sings his "toll-toll, pretty-little dé-ár." In his mossy-felted nest in the blossom-laden orchard there are four small reddish-green and purple-spotted eggs.

From dawn to darkness the happy sounds of life, no hour of silence; and in the favoured thickets, all night through, the liquid music of the nightingale, so delightful to the ear. What is pleasanter than, awakened at early dawn, to listen to the medley of bird voices. "Kuh, koo"; distant it seemed; was it fancy? A breathless pause, then unmistakably, so near and loud, "Kuh, koo; Kuh, koo."

R. A. STAIG.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification
in all Seasons of the Year

By HENRY IRVING

THE CONIFERS—LARCH, CEDARS,
CYPRESSES AND YEW

THE LARCH

THE most distinctive feature with respect to this tree amongst Conifers is that it is not evergreen. For some reason and advantage, it has, in the course of its evolution, acquired the habit, common to most of our trees outside the Conifer group, of casting its leaves as a preliminary to the winter sleep. It is of interest to note that a Larch seedling, during the first four years of its life, is partially evergreen—a surviving reminiscence of the tree's former habit.

The Larch is pre-eminently a tree of the mountain regions. Its shape is pyra-

midal, after the manner of the Firs. Its comparatively slight branches emerge in no very defined order from a central, tapering stem. These branches have at first a decided downward tendency, but sweep upwards towards their ends. Along them are ranged many branchlets, vertically suspended, forming a kind of fringe. In winter this tree has a peculiarly desolate appearance, more like that of death than sleep. But in spring there is no tree that awakens, in its vivid emerald robing, to a life more blithe and buoyant.

The bark, which is a reddish grey in colour, flakes off in scales, but also becomes strongly furrowed. The needles are

arranged singly and in a close spiral on the young, long shoots, but elsewhere are in spreading tufts. They are of a very

of the pendent branchlets. These are what Tennyson refers to as the "rosy plumelets" of the Larch. They are,



LARCH.

pure shining green in spring, deepening later, and changing to yellow before their fall in autumn. In texture they are soft, not hard and leathery as are those of the evergreens. Each needle is flattened.

The flowers, which appear at the same time as the needles, are oval in shape. The pollen-bearing flowers are yellow, the fruit-producing flowers a purplish red, erect by a manifest effort on the sides

however, on some trees a greenish white. Since these flowers grow abundantly on the lower branches, and there is, in consequence, no urgent need for the pollen's upward flight, its grains are not equipped with air bladders as is usual with the Pines. The cones, which mature and ripen their seeds in a single season, are about an inch long. Their scales open in the following spring, liberating the winged seeds. These are gradually shaken out by the wind, but



TRUNK AND BARK OF LARCH.

not readily owing to the erect attitude of the cones. The empty cones remain attached for several years, and, so accumulating, add much to the desolate winter aspect of the tree.

THE CEDARS

There are three of these, which are, however, generally regarded as merely geographical varieties. They are all mountain trees, as their names indicate: The Cedar of Lebanon, the Himalayan Cedar (Deodar), the Mount Atlas Cedar.

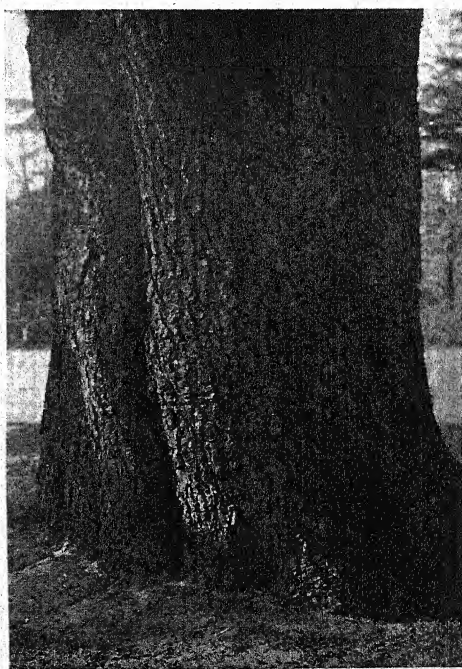
The Cedar of Lebanon, supreme type of venerable majesty among trees, is nevertheless of very variable habit. In its most characteristic form it throws out, at a rather low level, huge lateral limbs, which support at their extremities broad, platform-like areas of foliage, giving to the tree its distinctly terraced appearance. In maturity the summit also is usually broad and flat.

The other Cedars, as they grow in this country, are almost uniformly pyramidal like the Firs. The chief distinction between them is in the fact that, whilst the Deodar has its branches directed

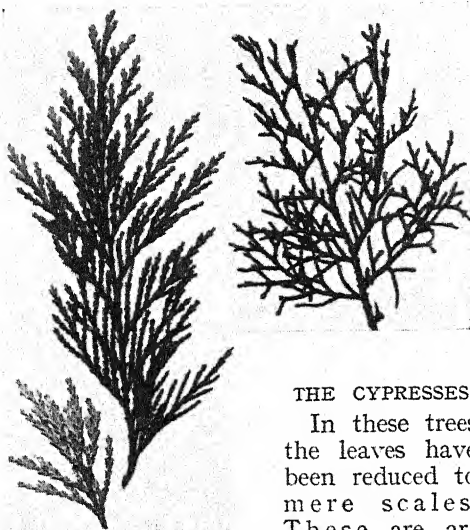
downwards, with their terminal shoots pendent, the Atlas Cedar has both its branches and its shoots erect.

The bark, a brownish grey in colour, is deeply broken up and roughened. The needles grow, similarly to those of the Larch, singly on the young, long shoots, in bristling tufts elsewhere. These tufts appear mostly on the sides and upper face of the branch. Each needle is hard and tough in texture, and is four-sided.

The flower clusters, which appear in the autumn, are solitary and erect. Both kinds are found on the same tree. The pollen-bearing flower clusters are particularly conspicuous as yellowish green spikes, contrasting strongly with the expanse of tufted dark green needles. The cones are erect, oval in shape, flattened or bluntly pointed at the top, and of a particularly solid structure. They require two or three years to reach maturity. The seeds are liberated, as in the also erect cone of the Silver Fir, by the shedding of the cone-scales, from the top downwards, leaving on the tree only a bare spike. The seeds are winged.



TRUNK AND BARK OF CEDAR OF LEBANON.



FOLIAGE OF LAWSON
CYPRESS (LEFT)
AND ROMAN CY-
PRESS.

THE CYPRESSES

In these trees the leaves have been reduced to mere scales. These are arranged upon the shoots and twigs in opposite pairs, with the alternate pairs at right angles. These fit so closely as completely to ensheath the shoot. The two chief Cypresses with us are the Roman (or Common) Cypress, and the Lawson Cypress.

Their usual form is flame-like, as that of the Lombardy Poplar. The flowers of both kinds are found on the same tree, but on different branches. They are very small, but being grouped more or less at the end of the previous year's shoots, and of distinctive colour, they are fairly conspicuous. The small cones are globular. They have but few scales, and these of a peculiar shape. Each separate scale is like a large-headed nail. The heads of these scales, pressed together and become pentagonal by pressure, form the outer surface of the cone. The cone

opens, to liberate the winged seeds, by the separation of these heads of the scales. The Thuyas, which otherwise most closely resemble the Cypresses, are easily distinguished by the absence of this peculiarity in the cone-scales.

The Roman Cypress has its branching close and dense. The shoots and twigs, with their sheathing leaves, are square in section. The pollen-bearing flowers are yellow, the fruit-producing flowers a brownish green. The cones are an inch in diameter.

The Lawson Cypress has a looser

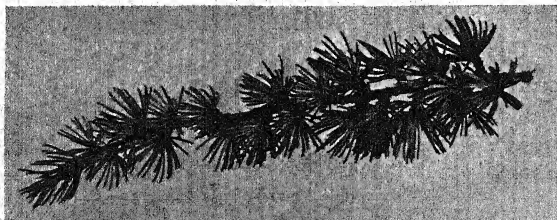


FOLIAGE OF YEW.

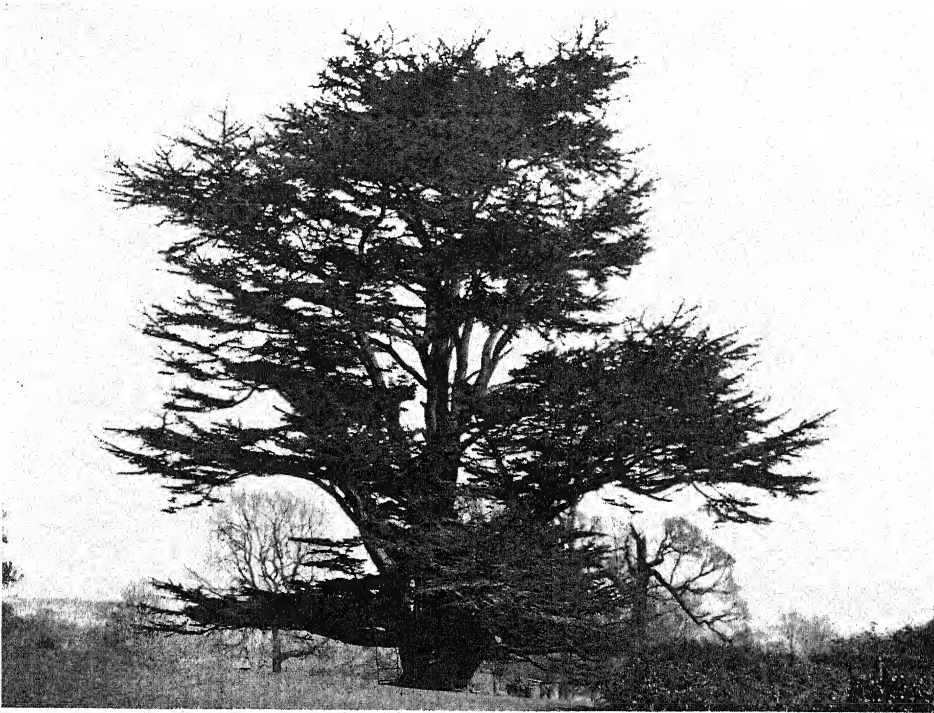
branching and a more flattened spray. The shoots, closely ensheathed by the leaves, are flattened also. The margins of the leaves are emphasised by waxy lines, forming a series of markings, V or Y shaped. The pollen-bearing flowers are a bright red, the fruit-producing flowers a steely blue. The cones are about one-third of an inch in diameter. This Cypress, though of recent introduction, is the one now most commonly met with.

THE YEW

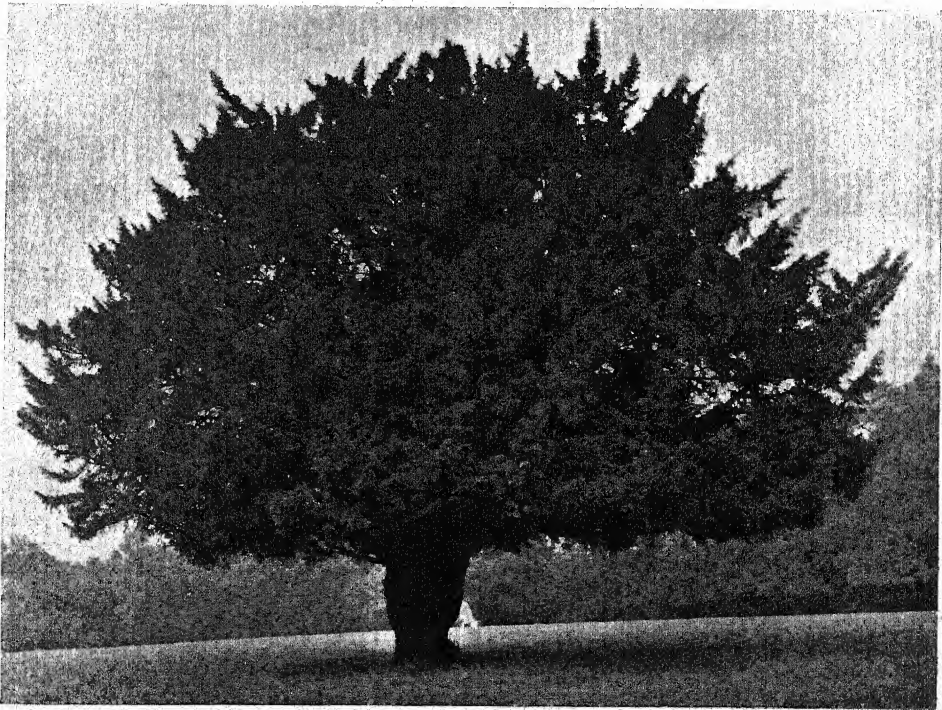
Even apart from its associations this tree cannot be overlooked. Its rounded massive build, its dark evergreen foliage, its columned trunk, often of immense proportions, its air of



FOLIAGE OF CEDAR OF LEBANON.



CEDAR OF 'LEBANON.



YEW.

antiquity, distinguish it instantly from all other growths. It is venerable from its association with ancient forms of worship, from its frequent occurrence in near neighbourhood of old church buildings, having, it may be, possessed the ground long before their walls were raised. The imagination is stirred at the thought that, without one hour's cessation, through all seasons and all changes of a thousand years and more, many an ancient Yew, vigorous still, has laid its quiet shadow on its own peculiar spot of sacred earth.

The trunk is really a composite structure.



ROMAN CYPRESS.

Branches growing up from the base have, in course of time, coalesced with the main stem, giving to it its columnar character. The bark, which is thin and fibrous, peels off. It is reddish brown in colour. The flattened narrow leaves, solitary, and

arranged in a close spiral, assume a combed-out attitude after the manner of those on the Firs. The pollen-bearing flowers, prepared the previous autumn, are attached in clusters to the under sides of the twigs. Their ripened pollen drifts



TRUNK AND BARK OF YEW.

away in clouds when shaken. Like those of the Larch, and for a similar reason, these pollen grains have no air bladder attachments. The fruit-producing flowers, with very rare exceptions, are on separate trees. They are difficult to find, being, in appearance, no more than minute green buds, whose floral structure can only be seen under the lens. The fruit is an olive green seed with a hard shell, partially enclosed, like a young acorn in its cup, within a brilliant scarlet receptacle, the walls of which contain a sickly-sweet mucus. Numerous birds find this attractive, and by their agency the seeds are dispersed.

A variety of this tree, the Irish Yew, frequently seen in gardens, is of columnar shape.

HENRY IRVING.

THE GARDEN SNAIL

By JOHN J. WARD

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.
Illustrated with Photographs by the Author

THE common Garden Snail (*Helix aspersa*) is a strange animal, whose dirty brown and grey shell, slimy exudations, and destructive habits in our gardens, quite alienate it from our sympathy. Nevertheless, the Nature lover may spend many a profitable hour in observing the curious habits of this leisurely-moving and even-paced *Gastropod*—as the zoologist prefers to call it, which, in plain language, means stomach-foot.

The lower exposed part of the snail's body consists of a large and broad muscular foot, and by means of this organ its locomotion is accomplished. The curious feature about this foot is that it is never lifted when its owner is moving. Its progress may be ever so closely watched as it glides over a pane of glass, but all that can be observed is a series of muscular undulations passing from back to front as the snail glides slowly forward. Although the snail obviously makes headway, yet just how it travels is a complete mystery; the whole of the time the base of the foot is closely applied to the glass, and is never seen to wrinkle with the forward movement.

The successive waves, commencing at the posterior end, are seen to travel completely through the substance of the foot to the anterior end, and the foot, therefore, appears to be continually shortening at its base and lengthening its fore part.

Of course, the whole body is really moving forward; how the motion is effected science has yet to explain.

Another remarkable feature about the snail's locomotion is that it always travels at the same pace; whether over loose or rough soil, the bark of a tree, a perpendicular wall, or a sheet of glass, the pace is always the same. If it is pursued by an enemy it cannot hurry, neither can it move backwards; its muscular mechanism having been put into use, it must run its course. Its only defence is completely to stop the machinery, as it were, and start another section by which it is withdrawn into its shell.

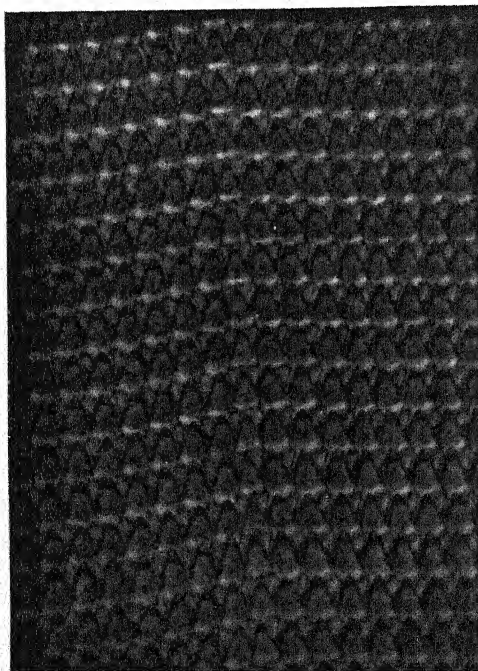
Seeing that an uneven, a too steep, or a too smooth surface always impedes our progress, it is at first astonishing that the soft body of the snail should maintain its even pace irrespective of differences in the surface over which it moves. It is, however, by means of the slime, or mucus, which it secretes that this equality of motion is obtained. According to the character of the surface in contact with the snail's body a greater or less quantity of this lubricating fluid is deposited, and in this slime the mobile foot always glides with the same amount of friction; hence the pace remains the same.

Around that part of the snail protected by the shell is a thin loose skin known as the *mantle*, and from secretions from the



THE GARDEN SNAIL.

edges of this organ the shell is built and extended as growth takes place. Likewise, when the gardener gives the snail a chop with his spade and smashes its shell, or throws it forcibly against the wall for the same purpose, from this mantle oozes out the repairing fluids, and so the snail becomes its own surgeon, joins up its broken parts and carefully cements



PORTION OF TONGUE OF EDIBLE SNAIL
(*HELIX POMATIA*).

The tongue of the Roman or Edible Snail possesses 140 rows of minute teeth. The total number of teeth is more than 20,000, and these form a rasp that can inflict serious damage upon garden products.

them together again. Then once more it goes on its way rejoicing to take toll from the lettuce plot, or, perhaps, to make one of its destructive forays amongst the young and juicy flower seedlings, and so recoup its strength; thus squaring accounts with the gardener for the injury he inflicted.

Turning to the senses of the snail, it is obvious that its sense of touch is very keen. It will only emerge from its shell in the cool of the evening when moisture and dew begin to accumulate, or after a shower when everything is

damp, for moisture is essential to its welfare. When kept quite dry it will often remain sealed up in its shell for weeks and months at a time, showing no sign of life. A little water sprinkled round about it, however, quickly causes it to detach itself from the tree or wall to which it has been clinging, and to glide forth in its slow and dignified manner, first extending its head slightly, and then its great stomach-foot, after which appear the two long "horns," quickly followed by the lower and smaller pair.

It is at the moment when the longer pair of feelers are extended, that the snail takes a peep to see if all is well, for the tiny black specks seen at the tips of the "horns" are its eyes. They wave gently to and fro, but at the slightest danger are retracted into the feelers, and the feelers into the head. Just what kind of a view of its surroundings the snail receives by means of its elevated eyes, we are quite unable to understand. Experiments tend to show that it is very short-sighted. The fact, too, that the retina is very close to the spherical lens, would also point to the same conclusion.

Near the eyes, on the tips of the feelers, are some curious minute skin cells, which are said to possess olfactory functions. The gleaming night-tracks made by the snail over the garden wall to some favourite feeding haunt, may, perhaps, be taken as evidence that the snail possesses a keen sense of smell. A snail will climb the bark of a tree, or a wall, night after night, to reach ripe plums, or other fruit, returning to its regular hiding-place behind the ivy, after its meal; for snails undoubtedly possess a strong homing instinct.

Furthermore, if, when a fully developed snail is seen approaching a ripe pear or plum, the fruit is suddenly removed, the snail will stop short and quickly extend and wave its feelers, as if trying to locate the scent of it. If the fruit is then put in a different place, the snail will often steer directly towards it. Such evidence would seem to prove that the snail possesses very sensitive olfactory organs; but that conclusion does not necessarily follow. The snail may be guided by something other than the sense of smell. If it is that, its olfactory senses are much

LAND AND FRESH-WATER SHELLS

Specimens required :—

COMMON SNAILS (*Helix aspersa*, *H. hortensis*)

POND SNAILS (*Limnea stagnalis*, *L. peregra*)

COIL SHELLS (*Planorbis*)

RIVER MUSSEL (*Anodon cygnea*)

LIVE SPECIMENS OF SNAIL AND SLUG

Structure

Note the shape and mode of growth of the shell. This is well shown in section. Note smooth nacreous layer inside the shell so that the soft body of the inhabitant is completely protected. The application of weak acid to the shell indicates that it is largely composed of carbonate of lime.

Examine the live specimens and distinguish the fleshy foot and head. Note also the slimy state of the outer skin. The strong muscular system of the snail and slug may be well observed if the specimen be placed in a glass jar.

Habits

The land shells are mostly nocturnal, and are vegetable feeders. They are provided with ribbons of teeth.

Obtain hibernating specimens in order to observe the protective covering of hardened slime, and also the breathing aperture.

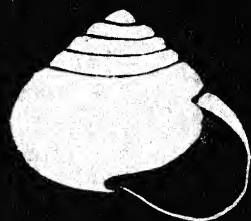
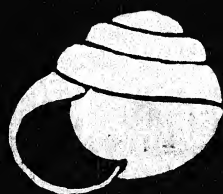
The pond snails should be studied in the school aquarium, in which they are useful scavengers. They remove the green growth (confervae) from the glass sides of the aquarium. This operation should be studied with a lens.

Other interesting but less common species are furnished by—

(a) The Trap-door Snail (*Clausilia*), which is to be found on tree trunks in summer—usually Beech.

(b) The Round-mouthed Snail (*Cyclostoma*), which frequents chalky districts. It is provided with a door (*Operculum*).

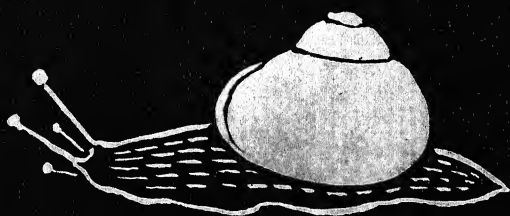
LAND & FRESHWATER SHELLS.



Land snails



Clausilia (found on trees)



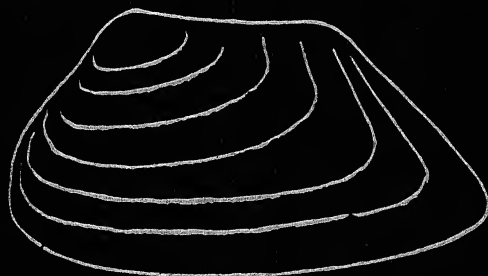
Snail - Helix



slug - Limax



Planorbis



Swan mussel



Pond snails



Shells of slug.

more highly developed than our own, for it can locate its food from afar ; and, to us, that food often has no sensible odour.

This point well illustrates the danger in drawing analogies from the human body. Seeing that the snail performs many sensory functions that are extraordinary to human comprehension, it is probable that it possesses senses that are not analogous with our own, and of which, consequently, we have no conception.

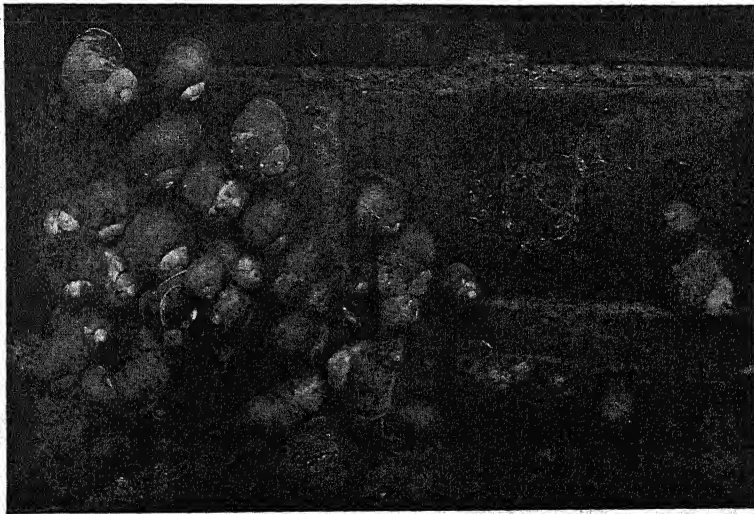
The snail's organs of hearing, if they exist at all, are most likely located in the upper surface of its foot, but, in any case, they are of a most simple character, and sound, as we know it, seems to have little or no effect upon the snail.

I am not aware that any organs of taste have been located in the snail, but, judging by its decided preference for fruits, peas, beans, and other choice commodities of the garden that are not intended for its use, it seems to possess strongly developed faculties in this direc-

tion. It is also assisted in this respect by the possession of most complex mouth-parts. Its tongue is a kind of rasping instrument, a file provided with more than 14,000 teeth in rows of about 100 in each. The thickened lips are pressed against the mushroom or leaf on which it is about to feed, in sucker-like fashion ; then the toothed file, or lingual ribbon, is applied ; and the damage that these numerous minute teeth can perform soon becomes apparent.

Its relation, the Roman or Edible Snail (*Helix pomatia*), which is found in some localities in England, possesses more than 20,000 teeth, some of which I have shown in one of the photographs ; but even that number is comparatively small, for one of its foreign relations is said to own a dental palate bearing 40,000 teeth ; and what is most remarkable in connection with these toothed rasps is that, as the rows of teeth in use wear away, other rows are formed to take their place.

JOHN J. WARD.



GARDEN SNAILS HIBERNATING DURING WINTER AGAINST A WALL THAT HAD BEEN PROTECTED BY A PIECE OF SLATE.



A HAUNT OF BREAM AND ROACH.

BRITISH FRESH-WATER FISH AND THEIR HAUNTS

By WALTER M. GALLICHAN

With Photographs by Mrs. C. G. GALLICHAN

BREAM, ROACH AND RUDD

ON a hot day in summer, when the sight can penetrate six to eight feet of water in a clear river, one may see the Bream at home. This opportunity is, however, somewhat rare, for Bream feed upon or very near the bottom, and they prefer still deeps and holes of streams. In the Norfolk Broads, where Bream abound, it is not easy to catch a glimpse of the broad-sided, silvery fish, because most of the Broads are shallow, and in some of them, such as Hickling, Barton, and Heigham Sounds, the water is bright, and Bream are easily alarmed by the approach of a boat. Wroxham, one of

the best of the Broads for the Bream angler, is not so clear as most of the Norfolk meres, but the water where the Bream lie is too deep for one to watch them.

The river that has afforded me the most favourable chance for observing Bream is the Gipping, between Ipswich and Stowmarket. In a mill-pool of this stream I have seen, in June, a shoal of sixty or seventy big Bream feeding near the bottom, and sometimes standing on their heads, while they "rooted" edible morsels from the mud. The Thames holds many good Bream, especially in the lower

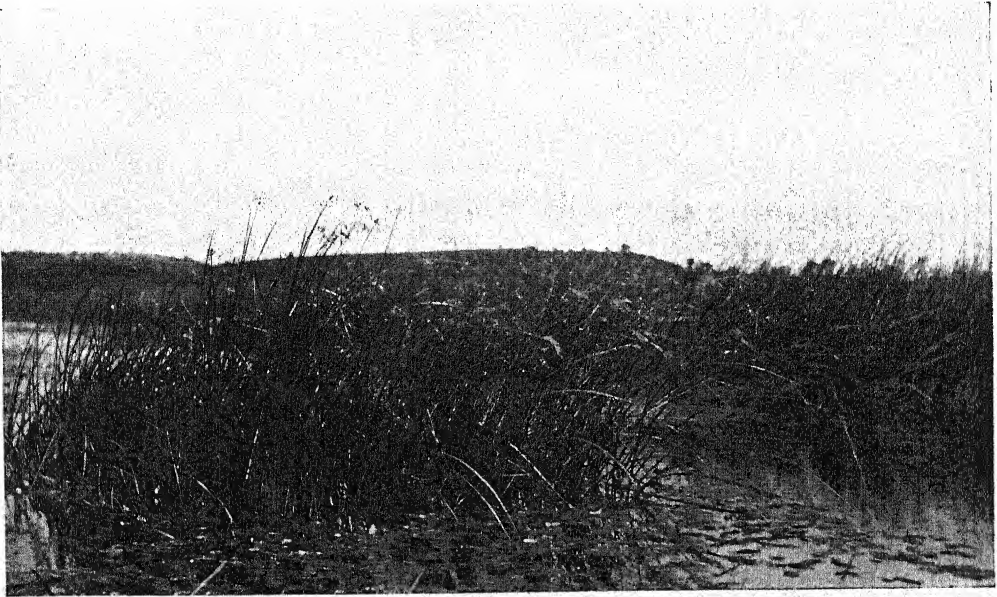
reaches above tidal water, and at Hampton, Sunbury and Shepperton; but although in bright weather one may see shoals of Roach, and occasionally barbel, in the Thames, I cannot remember catching sight of a Bream in that river.

Bream belong to the Carp family, and are easily recognised by their depth of side, their silver scales, and a touch of dull red on the fins. They are fond of rivers and pools with a muddy bed, and frequent most of the rivers of Eastern England, some of our canals, and many lakes and ponds in the English counties. They haunt the deep water of the Trent, and are fairly common in the Derwent above Derby.

There is not a very marked difference in the Bream of clear water and those that live in sluggish, discoloured rivers, though this species is subject to slight variation in

culinary value of Bream there is not much to be said. It is not a toothsome fish, though I have eaten it, with more or less relish, during yachting trips on the Broads. The mud-loving fish, such as the Bream, Carp, Tench and Rudd, are more interesting to fishermen and naturalists than to cooks, but are not of much account in the commercial sense. Sea Bream are dainty fish in comparison with the Bream of fresh water.

The habits of Bream are scarcely so well known as those of other common river fish. It is fairly certain that they spawn somewhat late in the spring, and that they are not in prime condition till well after midsummer. In winter they are sluggish, and seem disinclined to feed freely, though now and again I have caught an odd Bream or two while fishing for Roach in cold weather. As a rule,



A WEEDY HAUNT OF ROACH.

colour. The White Bream, or Bream Flat, found in Ireland, and in some of the eastern counties of England, has bigger scales than the Common Bream, a tinge of red on the body, and redder fins. Bream from Hickling Broad are said to be more silvery than the Bream of Wroxham, and they are better when cooked. But of the

the hottest days give the biggest "takes" of Bream, which is well for those anglers who take their holidays in August. Frost appears to benumb Bream, and it is probable that, like Carp, they burrow in the mud during severe cold.

In the height of summer, Bream swim in big companies, and a procession of

these sedate fish may be seen occasionally in shallow meres.

Bream have been caught from English waters up to ten pounds in weight, and they are said to attain occasionally the weight of twelve pounds. Six pounds is a not uncommon weight in Norfolk and



A DYKE FREQUENTED BY ROACH AND RUDD.

Lincolnshire for the well-fed Bream of the Broadlands and Fen rivers.

Roach are of the same family as the Bream. In shape they are less broad; the lower fins are a bright red, and the eyes are tinged with red and gold. The red hue of the Roach is the origin of its name in France, *i.e.* *rouget*, from *rouge*. "He is a fish of no great reputation for his dainty taste," writes Izaak Walton, in "The Complete Angler." In the Ardennes, Roach often formed the first dish at the hotel where I stayed, and I may say that the skill of the cook rendered the fish quite palatable. If the Roach is not greatly esteemed for its edible quality, it is the fish most valued by bottom anglers in this country and in France. There are enthusiasts who concentrate all their angling cunning and

dexterity upon the capture of Roach. In Walton's day, "the great Roaches about London" afforded recreation to the "best Roach anglers," and this holds good to-day. The Thames Roach are extremely wary, and the methods of fishing for these are necessarily "fine."

Roach are widely distributed in our waters, and they thrive in meres, ponds, rivers and canals, selecting in preference those parts of a pool or stream that have a hard gravel bottom. They swim in shoals near the bed of a river, but now and then they come to the surface of the water, and feed upon floating insects. Roach will eat a green, soft weed that grows on weir piles and the submerged roots of trees, and in the lower Thames, this weed is sometimes used as a bait for the angler's hook. Their chief enemy among fish is the Pike, and Eels and Perch consume a number of the fry.

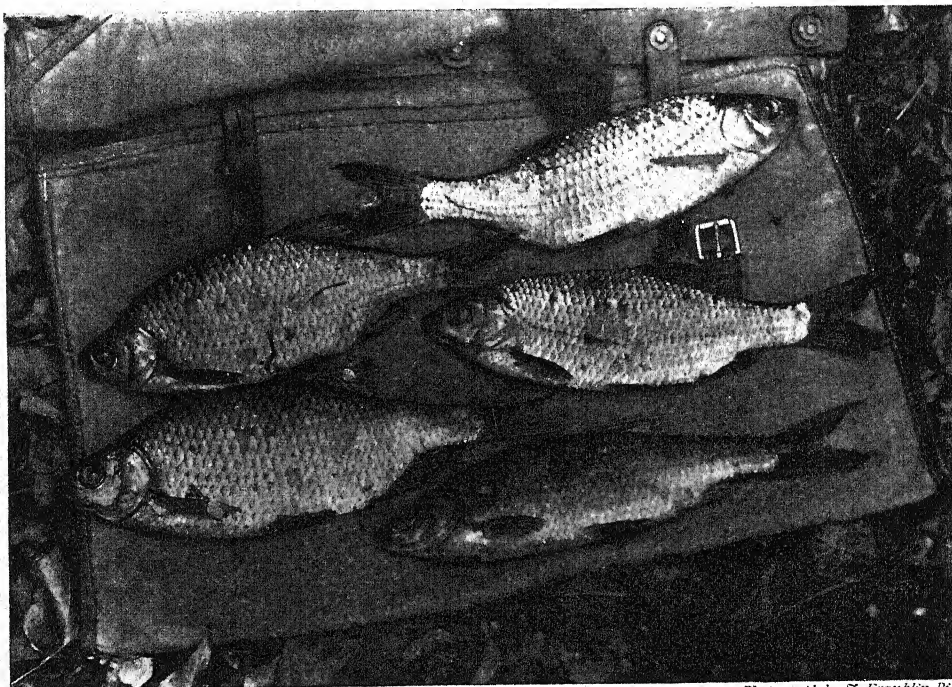
In the summer, Roach are fond of roving, and they may be seen, in companies, exploring the shallow dykes of Norfolk and the Fen district. River Roach are brighter than those bred in ponds. In streams with a quick flow and a gravel bed, they are silvery and handsome. This is the character of the Roach of the Avon and some other Hampshire rivers, which produce very fine specimens.

Roach spawn in the late spring, and at this season their scales are rougher than at other times. They are very prolific fish, and when introduced to ponds often increase so rapidly that they diminish the food supply and degenerate into dwarfs possessed of an extraordinary voracity for bait, and almost devoid of their normal quality of caution. In a favourable environment, Roach sometimes grow to three pounds in weight; but a Roach of two pounds is an angler's prize, and one weighing a pound is considered a good example in the Thames, Trent, Lea, and Severn. Pennant mentions a Roach of five pounds, which was captured in English waters, but there is doubt concerning the accuracy of this writer's records of big fish.

Until about the year 1730 Roach were netted from the Thames opposite the Temple, and at Blackfriars and London Bridges. For very many years the Thames was so polluted below Richmond that few

fish could live in its water; but the capture of more than one variety of fish from among the piles of Blackfriars Bridge, during the rebuilding in 1908, proves that the Thames is becoming a purer stream. Two or three of the London docks seem to have been free from the poison of Thames water until about 1860, for Roach were caught in the Surrey Canal Dock,

the surface. They are not so common as Roach, though they abound in some of the Broads and in several meres in various parts of the kingdom. In Ireland the Roach is said to be unknown, but the Rudd inhabits Irish waters. Slapton Ley, in Devonshire, is famous for Rudd, and many are caught from Barton Broad in Norfolk. In Coombes Reservoir, in



A CATCH OF RUDD.

Photograph by J. Franklin Pike.

at Rotherhithe, and in the East and West India Docks.

The Rudd, sometimes called the Red Eye, was formerly looked upon as a hybrid, but is now regarded as a distinct species. In Wales, where Rudd are very local, the fish is known as the Rhudd-goch, meaning crimson-red, which well describes the hue of the fins. Rudd are of the Carp family, and the near relations of Roach. They can be distinguished from Roach by the depth of their sides, the nearness of the dorsal fin to the tail, and the brighter colour of the fins. Rudd differ somewhat in their habits from their allies the Roach, for they swim higher in the water, and come more frequently to

Derbyshire, in Teeton Reservoir, Northampton, and in Whinfell Tarn, in the Lake District—three dissimilar waters—Rudd are found, but they are most plentiful in the eastern counties.

The "occurrence" of Rudd in Whinfell Tarn, recorded by Mr. John Watson, in "The English Lake District Fisheries," is highly interesting, as this is an upland lake and unlike the mud-bedded Broads of Norfolk. Mr. Watson relates that Dr. Günther has identified the fish as Rudd (*Leuciscus erythrophthalmus*), and that they appear to be mostly a pound in weight. In Teeton Reservoir Rudd are the companions of introduced Trout, and no doubt the fine and rapid growth of

the Trout is due to their feeding upon immature Rudd. Around Ellesmere, in Shropshire, Rudd breed in several pools. They are not natives of the Thames, but some hundreds of the species were turned into the river a year or so ago in the neighbourhood of Weybridge.

The existence of old Rudd ponds in several parts of England seems to prove that our forefathers reared Rudd as they reared Carp, and kept them in "stews" or preserves. It is probable that these ancestors of ours knew some trick of cookery which could make Rudd a presentable fish on the table. Nowadays, Rudd are not esteemed as delicacies.

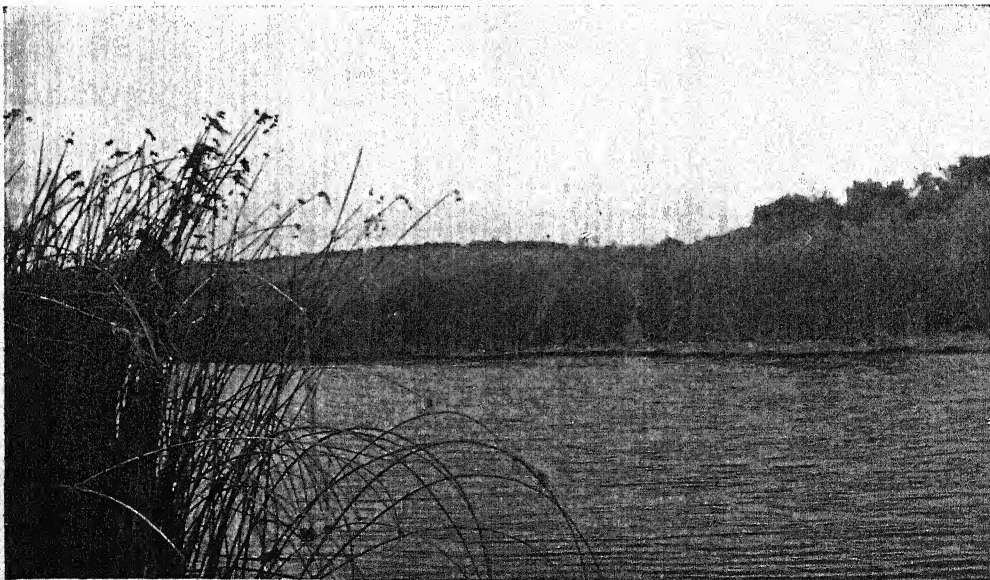
Rudd spawn at about the same time of the year as Roach. They feed on the bottom as well as upon surface food, but in frosty weather they probably dive into the mud and remain inert. Rudd in the Broads may be seen in bright sunshine, swimming among the stems of the water-lilies, though it is not always easy to conceal oneself from the eyes of the fish. Mr. F. G. Aflalo states that Rudd kept in captivity have been known to feed on small minnows, but it is very doubtful whether they are predatory when living in freedom.

Rudd are the prey of Pike and Perch,

and herons capture a few now and then on the shallows. They roam in the summer, and apparently travel two or three times during the day around some of the Broads, for troops of Rudd may be seen frequently passing a given point. In the Kessingland Stream I have noted that Rudd and Roach swim together in shoals in hot weather.

Rudd, in my own experience, are less shy than Roach, and more apt to expose themselves to observation in shallow waters. They are, however, fairly shrewd in meres that are much frequented by fishermen. The haunts of Rudd in the east of England are associated in one's mind with beautiful corners of quiet Broads, where the water-lilies expand their pure petals of white, the swallows flash to and fro, the loosestrife and meadowsweet deck the bank, and the sedge warbler's note is heard among the tall, gently waving reeds. It is pleasant to recline in the boat and to watch the denizens of the clear, shallow water, that swim now and then within sight. And at sunset, when the Broad is lit with gold and crimson, one may see the big Rudd rising here and there at the dancing flies that touch the water with fairy feet.

WALTER M. GALLICHAN.



A RUDD MERE.



THE BROWN RATTON, A LOCAL VARIETY OF *MUS RATTUS*, FORMERLY KNOWN AS THE ALEXANDRINE RAT.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE RATS AND RATTONS

With Photographs by the Author

IN a previous article I suggested that the old English term "Meadow Mouse" (which has a distinct flavour of its own) should be preferred in popular speech and writing to "Vole." The nomenclature of our British Rats calls for a similar revision, and the necessities of the case would, I think, be best met by the revival of the old term "Ratton." An expression is needed which shall distinguish the species scientifically known as *Mus Rattus*—which is at once cosmopolitan in distribution and bewildering in variety—from the larger and clumsier species, which is scientifically known as *Mus Decumanus*, and popularly—perhaps I should say unpopularly—known as the Common Brown Rat. There are at least three varieties of *Mus Rattus* not uncommonly met with in certain of our

seaports, and these I would designate the Blue Ratton, the Black Ratton, and the Brown Ratton. I would reserve the title of Brown Rat for the ubiquitous and unmistakable *Mus Decumanus*, and I would call its melanistic variety the Black Rat.

So far as external form is concerned, I hope that my photographs will enable the reader to distinguish with ease between Rat and Ratton. It will be noticed at once that the latter are built on finer lines than the Rats, that they have more tapering muzzles, longer tails, larger ears, and more prominent eyes. The dimensions of the average Rat are about a third larger than those of the average Ratton. This superiority in size (and a corresponding superiority in strength) has proved the determinant factor in a struggle for

existence between the two species, which is actually in progress, at the present moment, both in Europe and America. Its progress in the past has been marked in many localities, including the British Isles, by the practical annihilation of the unfittest. Apart from the disparity of strength between Rat and Ratton, the prominence of the latter's eyes and ears are a decided handicap to him in battle, and it must also be remembered that the "weeding out" process, which naturally accompanies migration, ensured that the Rattons should be attacked in the first instance by a race of hardy campaigners.

The coloration of the Common Brown Rat hardly needs description. There is generally a sharp differentiation between the grey brown of his back and the white of his belly, and his body fur is decidedly coarse. In the Brown Ratton we find the same colour scheme predominant, though the fur is of much finer texture. In the Blue and Black Rattons the body pelage presents a peculiar metallic sheen, typically bluish in the Blue Ratton and typically greenish in the Black, while the colour of their bellies differs but slightly from that of the sides and upper portions of their bodies.

The history of Rats and Rattons is of great interest. It is certain that Rattons of some kind inhabited Europe before the dawn of history. Remains of the species have been found in West German pile dwellings, and also in Italy, under circumstances which leave no reasonable doubt as to their antiquity. The Brown Ratton first attracted attention during Bonaparte's occupation of Egypt, and was named the Alexandrine Rat by Geoffroy. Until the investigations of De l'Isle in 1865 proved that it was impossible to separate him anatomically from the Blue or Black Rattons, he was regarded as a distinct species. De l'Isle advanced the theory that the Brown Ratton was the primitive type. An interesting series of breeding experiments showed him that the mating of a Black male Ratton with a Brown female produced generally an all-black litter, while the mating of a Brown male with a Black female produced generally a mixed litter in which the darker tint predominated. He further suggested that there was a

tendency in parasitic animals of the genus *Mus* to become uniformly dusky in tint and to lose the dark upper-, light under-coloration, which is characteristic of so many wild creatures, and which is held to be protective by reason of the light portions being normally in shadow.

On these grounds he held that the original out-of-doors Ratton was brown above and white below, this being the combination which best suited his normal environment, and that the all-over duskiness of the prevalent European type was an adaptation to indoor surroundings. De l'Isle's theory held its ground for a generation, but it was disputed by Forsyth Major, and it is the latter's view which is now generally preferred. This view is based on the palæontological aspect of the case. It is an observed fact that highland species tend to be darker in colour than lowland species. In cases where a single species includes both highland and lowland varieties the tendency to melanism in the former is marked. It has been observed in the common squirrel, in bats, in meadow mice, and in several species of reptiles and amphibians. If we admit that colour variation is chiefly a matter of climate, and assume, as we are almost certainly justified in assuming, that the climate of N.E. Africa and Arabia in the Quaternary Epoch was similar to that of modern Europe, the probability of the original immigrant Ratton having been as dusky as his modern mid-European descendants becomes an extremely strong one, and the evolution of the Brown Ratton from the primitive black type must be attributed to the gradual climatic change which turned the quaternary moors into sandy deserts.

The incursion of the Brown Rat into Europe occurred less than two hundred years ago, but we know nothing of the causes which impelled him to cross the Volga, nor have we any certain knowledge as to whence, or why, he came. It is practically certain that he did not come from India, where Rattons abound, and it is likely that his original home was considerably further to the East.

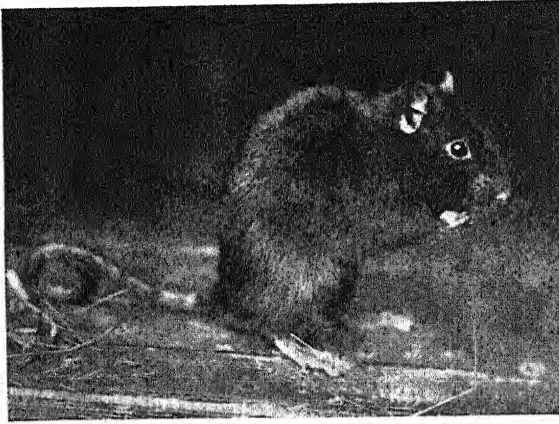
His passage of the Volga, which was to be fraught with such grim meaning for the European Rattons, occurred,



RAT AND RATTON.

1. THE COMMON BROWN RAT. 2. THE BLUE RATTON ("OLD ENGLISH BLACK RAT.")

The distinction in size and build can be well seen in these pictures. The heads should especially be compared.



A BLACK RAT.

Probably a melanistic variety of the Common Brown Rat, *Mus Decumanus*, the ears being too small and the nose too blunt for *Mus Rattus*.

according to the Russian naturalist, Pallas, in 1727. A few years later he arrived in England, ship-borne from some unknown port, and, in a hundred years' time, had so taken advantage of the British carrying trade as to have overrun the world. Wherever exigencies of space, or scarcity of food, have brought him into direct conflict with the Ratton, the weaker species has gone to the wall. There is no interbreeding between them, and the ultimate fate of the Ratton at the hands of the Rat is complete extermination. It is probable that the Ratton of this country—the old English Black Rat of two hundred years ago—*was completely exterminated*. Both Rats and Rattons, however, are born sailors (how otherwise can we account for their survival through rough weather when the alternative to being smothered in grain or copra, is being drowned in bilge?), and it is to the accidental settlements of alien Rattons in our seaports (London being the chief, though most stringent precautions are taken to prevent Rattons getting outside the docks) that we owe the periodical rediscoveries of the "Old English Black Rat."

About ten years ago, in company with Mr. H. C. Brooke, to whom the credit of first distinguishing between the Blue and Black Rattons, and the discovery of the Brown Ratton in this country, is certainly due, I investigated the dis-

tribution of Rattons in north-west Kent. It was well known to us that they had existed for a long time previously in Woolwich Arsenal—indeed, I had been informed by one of the oldest employees there in 1888 that they (Black Rats) "had troubled him ever since he could remember"—but we were hardly prepared to find a flourishing colony of Brown, Black, and Blue Rattons so far outside the Arsenal gates as Welling. It was from experiments with specimens from this locality that I satisfied myself that Black and Blue Rattons interbred with each other, but would not interbreed with the Common Brown Rat.

Does of all three varieties were very scarce—indeed, I never secured a Brown Ratton doe at all, nor did I succeed in mating a Brown Ratton buck with either a Black or a Blue doe. The shyness and timidity of all the Rattons which passed through my hands was in remarkable contrast to the bold resourcefulness of the Common Brown Rat. A fastidious cleanness was perhaps their most engaging feature—rather than endure a week-old nest they would sleep on bare boards. In view of the close connection between Rattons and plague, a disease which is presumably engendered under peculiarly insanitary conditions, this fact is curious.

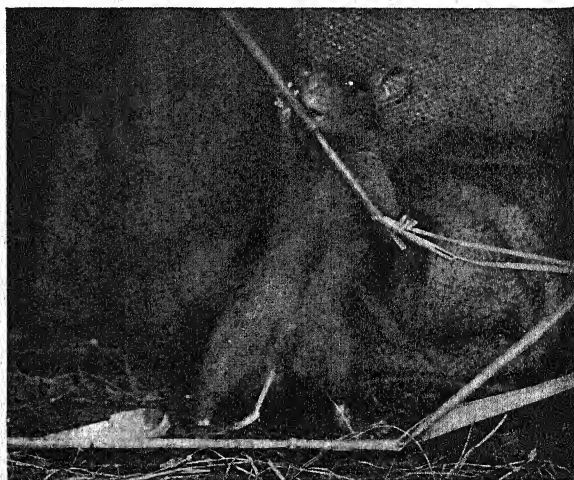
It has been conclusively proved by investigations in India that Rattons are highly susceptible to plague. In a paper read before the Bombay Natural History Society (*Journal*, vol. xvi. pt. 2) Captain Liston, of the Indian Medical Service, defines plague as a "rat disease," and classes it, by reason of its being readily communicable to man, in the same category as anthrax, glanders, and hydrophobia. Infection is accomplished through the agency of a definite flea, *Pulex Cheopis*, which, though normally confined to Rattons, will, under stress of hunger, desert its dead or dying host, and fasten, with its stomach full of germs, on the first new host which offers. *Pulex Cheopis* has definite antipathies. He shuns the light; he dislikes oil and tobacco. The danger

of plague infection is therefore materially increased by dark surroundings. People whose callings necessitate the frequent handling of oil are comparatively immune, and the same may be said, though in less certain fashion, of tobacconists. It is comforting to realise that our own Common Brown Rat harbours a different species of flea, *Ceratophyllus fasciatus*, and that a definite connection between the Common Brown Rat and *plague* has yet to be established, though it seems certain that there is a definite connection between the Common Brown Rat and *trichinosis*.

I hold no brief for the Brown Rats. The horror of the Lewisham tragedy in November, 1904 (by no means the first or last of such), when a six weeks old living infant was gnawed to death by these vermin, is fresh in my memory, and no doubt many of my readers will recall the tale of woe from the Gaiety Restaurant, "1728 serviettes behind the wainscot of the band-stand," and many similar tales which provided entertainment for newspaper readers during the construction of Kingsway. Reflection soon shows the serious aspect of these incidents. Serious, too, are the size of the record Rat (Malton, August, 1881, length 23 inches, weight 2½ lbs.), the comparative frequency of the baker's dozen in Rat litters, the reckless courage of the Rat, the athleticism of the Rat, the omnivoracity of the Rat, the cunning of the Rat, and the ubiquity of the Rat. I admit all these counts of the indictment against him, but at the same time I think it right to call attention to the fallacies which underlie the statistics recently advanced by the Incorporated Society for the Destruction of Vermin to show the loss of wealth occasioned by the presence of Rats in this country. Mr. Boelter, a member of the Society's executive committee, reckons the value of a Rat's meals at one farthing per diem, and estimating the number of British rats at 40,000,000, arrives at an annual food bill of fifteen million pounds. I have no quarrel with Mr. Boelter's figures,

but I must protest against the assumption that whatever enters a Rat's mouth and passes through his body is a dead loss of wealth to the country. We must put to the credit of our forty million Rats not only their services as scavengers, but also their services as fertilisers. We must further credit them with checking to a very marked extent the excessive increase of furred and feathered vermin smaller than themselves, not to mention insects, reptiles and batrachians. Allowing that even so there will be a considerable balance on the debit side, we must consider the best means of restoring that balance of Nature which we ourselves have allowed to be disturbed. The dangerous increase of Brown Rats in this country is, in my judgment, entirely due to the apathy with which we have permitted the interests of the game preserver to take precedence of the interests of the community. This state of affairs should cease. Badgers, otters, martens, polecats, stoats, weasels, owls, hawks, buzzards, all creatures, in fact, which naturally prey on the *Muridæ*, should be strictly protected for a term of years. Instead of encouraging breeds of dog and cat, which are fit for little else than smirking on show-benches, we should encourage breeds which take naturally to ratting, and which ask nothing more than to be allowed to indulge their proper instincts.

In the present state of affairs traps and

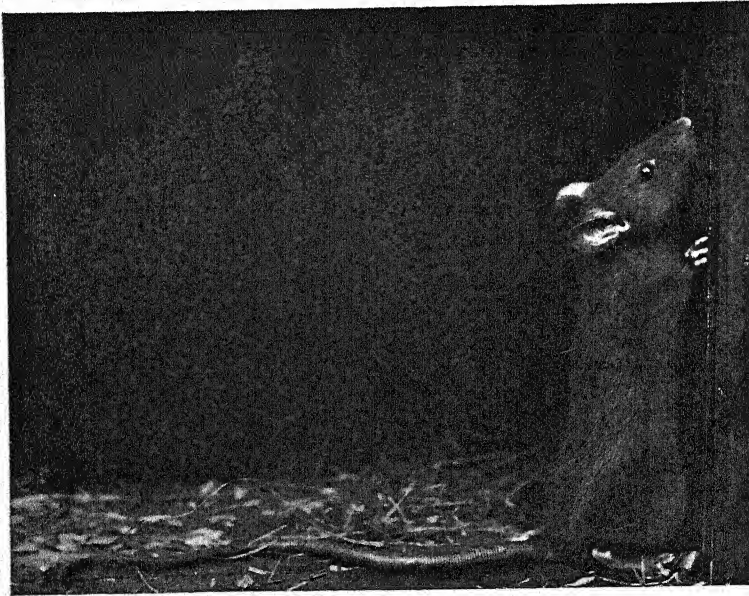


A BLUE RATTON COLLECTING NEST MATERIAL.

ratbanes are about as effective as incantations. Ratbanes, to be of any service, must contain some dangerous poison such as arsenic, strychnine, or cantharides. It is questionable whether their use is legal, and, in any case, it is extremely

of suppression in this country. No bacteriologist knows or can pretend to know what the ultimate effect of spreading disease among the forty million Rats, to say nothing of the many times forty million mice and meadow mice in this

country, would be. Presumably a large percentage of the rodents affected would die; presumably, too, a certain percentage would recover, and possibly be rendered immune. Efforts would, of course, be made to collect and cremate all the corpses, but how many would actually be collected, and how many would putrefy unseen? The Brown Rat would use his last grain of strength in



A BLACK RATTON.

The closeness and smoothness of the fur, which has a green metallic sheen, should be noticed, also the large size of the ear and the great length of the tail.

risky. Practically the only alternative we have to an endeavour to restore Nature's balance by natural means, is the employment of bacteria, and it is this method which has been adopted by the Danish Government. Several different forms of virus are on the market, and it is naturally claimed for all of them that they infect Rats with a specific disease, which is communicated from one Rat to another. However careful the laboratory experiments may have been, and however certain the advertisers of these cultures of bacteria may be of the safety and efficacy of their employment, it is greatly to be hoped that the Incorporated Society for the Destruction of Vermin will hold its zeal so tempered by discretion as to await the final result of the Danish experiments before encouraging any but natural means

reaching cover. It is claimed for the bacterial preparations on the market that they are specific to the *Muridæ*. Is anyone bold enough to suggest that *bacillus typhi murium*, or any other bacillus, has been proved innocuous to any and every form of life with which a sick Rat may be brought in contact? It is to be hoped that the Incorporated Society for the Destruction of Vermin will be content for the present to devote its energies to the protection of the furred and feathered enemies of Rats. If the Danish Rats are exterminated by the use of "Ratin," the Society will be able to appraise in a few years' time the result of such extermination; if "Ratin" does not exterminate the Danish Rats, the Society will be at least in a position to determine what it does do.

DOUGLAS ENGLISH.

THE KINSHIP OF PLANTS TO ANIMALS

An interesting theory suggesting that plants possess rudimentary senses

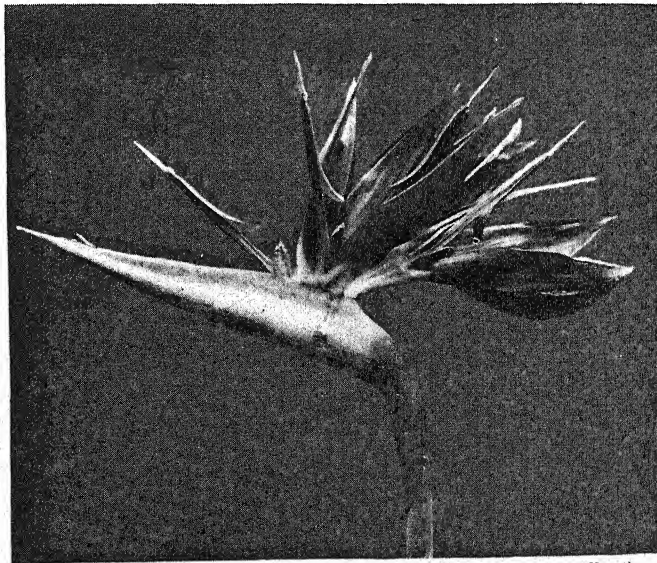
By WALTER P. WRIGHT

THE theory of Mr. Francis Darwin that plants have senses closely akin to those possessed by animals—that they can see, feel and smell—has done more than arouse controversy among scientists; it has arrested the attention of that large section of the general public which strives to look with seeing eyes into the manifold processes of creation.

The theory is at once picturesque and stimulating. It immediately extends the view and widens the sympathies of mankind. It links plants with humanity in closer bonds. We feel that the flowers which we have cultivated from selfish motives—for the pleasurable sensations which their colour and perfume impart—may well minister to the finer emotions of love and friendship. They are an integral part of the vast, yet simple, evolutionary scheme which has peopled the orbs in the solar system with their myriad forms of life.

Many who may have looked askance at evolution because of an unconquerable repugnance to the association which it entails with the lower forms of animal life may be expected to consider it with sympathy when it not only brings within its scope, but gives new attributes to, beautiful plants. They will look on the

sprawling sprays of the wild rose, the snowy cumuli of the Traveller's Joy, the ivory spires of the chestnut, the golden cascades of the laburnum, with a sense of intimacy, of oneness, that can hardly



Photograph by E. J. Wallis, Kew Green.

BIRD OF PARADISE FLOWER (*Strelitzia Regina*).

fail to have a far-reaching effect both on their imagination and their hearts.

It needs but a very slight study of plants to perceive that there is evidence of intelligence among them which puts them at once on a par with at least the lower animals. They breathe, they move, they simulate other objects, they develop extraordinary and beautiful processes for reproduction, self-preservation and securing nourishment. Roots, stems, leaves and flowers alike appear to be capable of

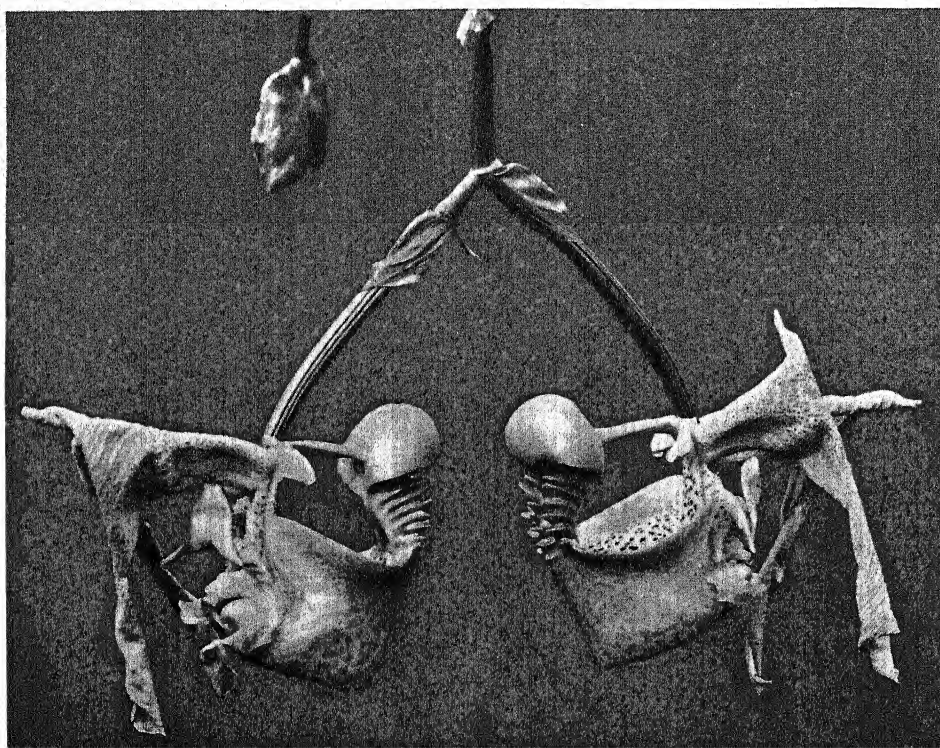
modification in order to achieve certain objects. These things cannot be accepted as merely fortuitous. They point as clearly to design as the motions of the planets.

Take certain instances of what might be termed peculiarity or eccentricity, but which in some cases might be described as intelligence on the part of plants. I do not think that this word should be withheld because the object which the plant has in view is not apparent to human beings. The five senses of man have hitherto proved wholly inadequate to explain many things which are subjects of common knowledge, but a sidelight may some day serve as a guide.

The great family of Orchids gives us many remarkable examples of plant intelligence. We find flowers of wonderful structure and gorgeous colour. In many instances they mimic animals or insects, in others the various parts of the flower are developed in peculiar ways, which can only be explained as aids to fertilisa-

tion. Four extraordinary examples of mimicry are the "Man," "Bee," "Lizard," and "Spider" orchises, which mimic the various animals and insects after which they are named. The "Bee" orchis (*Ophrys apifera*) is familiar to many botanists in this country, who have found it during their rambles, and have been struck by its bee-like form.

An example of the folly of dismissing as fortuitous whatever may be unexplainable at the moment when it is first observed is presented by the exotic orchid known to botanists under the formidable name of *Angræcum sesquipedale*. The waxy, white flowers are five or six inches across, and each is furnished with a spur ten to twelve inches long containing nectar. What was the object of this appurtenance? Botanists looked around, considered, and found nothing to explain it. For many years it remained a mystery. Recently, however, a moth has been discovered in Madagascar, which is the home of the plant, with a specially

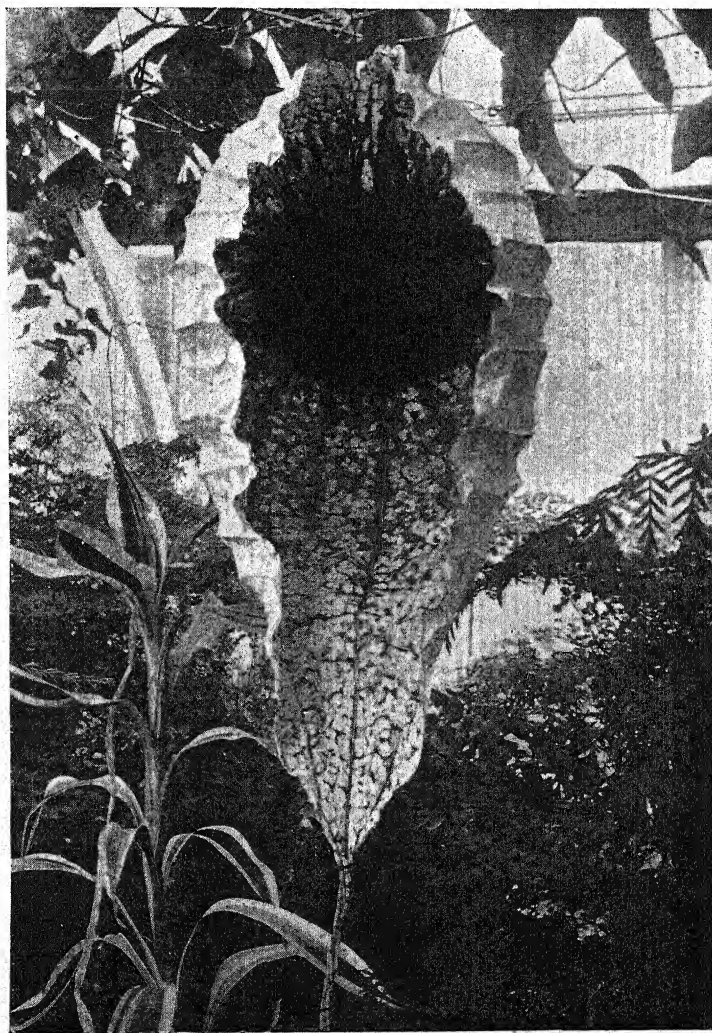


THE "BUCKET" ORCHID.

Photograph by E. J. Wallis, Kew Green.

developed proboscis long enough to reach to the bottom of the spur, and in visiting the flower in search of nectar the insect assists in cross-fertilisation. This is but one of many instances which might be

of which have developed long, tail-like appendages; in the "Butterfly" orchid (*Oncidium papilio*), with its brown and yellow spotted flowers; and in the "Dove" orchid (*Peristeria elata*), the



THE PELICAN FLOWER (*Gigas Sturtevantii*).
Photograph by S. L. Bastin, Lyndhurst.

quoted of a relationship between flower and insect too perfectly intimate to be dismissed as "chance."

Singularity and beauty of form are united in the "Lady's Slipper" orchid (*Cypripedium*), the pouch-like flower of which resembles a slipper; in other forms of *Cypripedium* the side petals

central portion of which has the outline of a dove.

The *Stanhopeas* are brilliant and fragrant orchids, and they have the peculiarity that the large, waxy flowers are pushed between the roots, and appear below the basket in which the plant is growing. The *Coryanthes* produce their flowers in

the same way. The beautiful blossoms of this orchid (see illustration) have an abnormal development of the lip, which in some instances forms a large pouch, and has led to the name "Bucket" orchid being applied to the plant.

In some orchids certain parts of the flower are very delicately balanced, and are sensitive to the least breath of wind. A remarkable instance of this is *Bulbophyllum barbigerrum*, the lip of which is poised with the nicest accuracy, and terminates in a fringe of hairs; as a result the lip is as restless as a two-year-old boy. The *Masdevallias* show a great range of forms, and one of the most singular is that shown in the photograph, *Chimæra backhouseana*.

Among orchids with peculiarities of foliage may be cited *Cynorchis purpurascens*, which has only a single leaf.

Leaving the orchids, we may glance at the curious genus of climbing shrubs known as *Aristolochias*. The flowers are distinguished for peculiarity of shape and offensive odour. There is a hardy species called *sipho*, which is commonly called the Dutchman's Pipe, on account of the shape of the tiny flowers. Then there is the tropical species *macroura*, which produces comparatively small, contorted blooms, the chief peculiarity of which is the elongation of one of the petals.

It is two inches across in one part, from which it suddenly narrows into a string-like tail two feet long. The species *brasiliensis* has been called the "Bird's head," and engagingly described by one

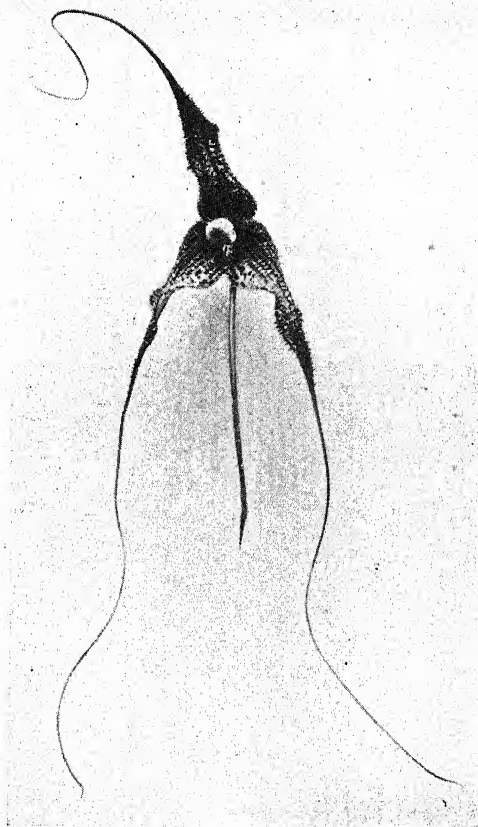
authority as having "the head of a hawk, the beak of a heron, and the wattles of a Spanish fowl." But the most remarkable of the *Aristolochias* is certainly the "Pelican flower" (*gigas Sturtevantii*), the buds of which resemble a pelican in the water. The expanded flowers are often eighteen inches across, with tail-like appendages three feet long. (See photograph, page 751.)

South Africa gives us a very singular plant in the "Bird of Paradise flower" (*Strelitzia regina*) which is shown in the photograph on page 749. The popular name takes its rise from the curious arrangement of the petals, the beak-like pistil, and the

colouring. The petals are orange, and the pistil and stamens deep blue.

The martial title of "Artillery plant" appears, on the face of it, far too formidable for so modest and inoffensive-looking a plant as *Pilea muscosa*. When, however, it sets up a miniature bombardment by discharging pollen in sharp puffs from its stamens the name is seen to be less inappropriate. The device may be one for furthering fertilisation.

WALTER P. WRIGHT.



Photograph by E. J. Wallis, Kew Green.
MASDEVALLIA; CHIMÆRA BACKHOUSEANA.